APRIL 1967 35 CENTS

Popular Science

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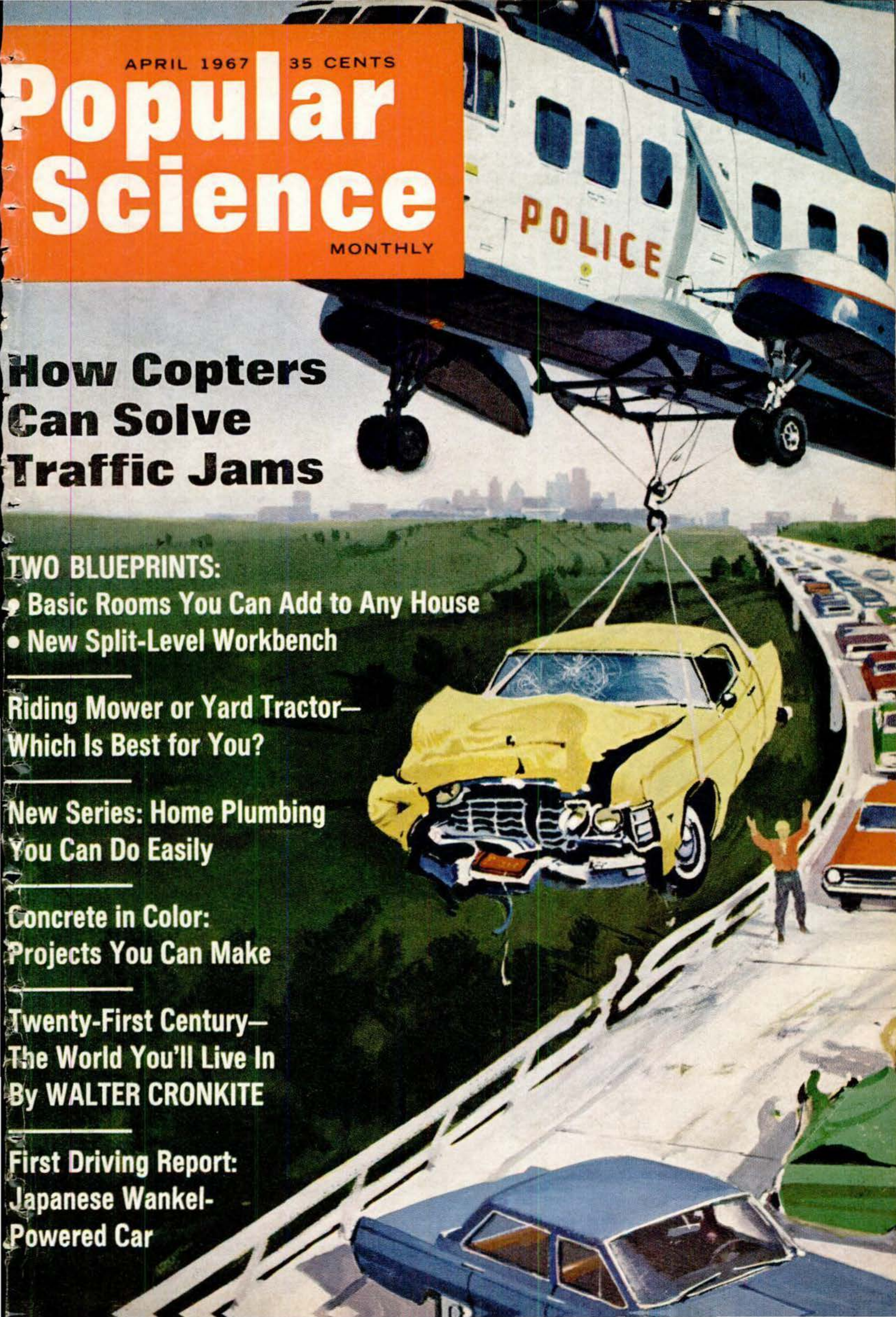

How Copters Can Solve Traffic Jams

TWO BLUEPRINTS:
- Basic Rooms You Can Add to Any House
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Here's help for traffic-stalled motorists: Whirlybirds that lift wrecked cars off the road.

The World You'll Live In BY WALTER CRONKITE PAGE 98
What'll it be like in the year 2000? TV's famous news reporter takes you on a visit.

Riding Mower or Tractor . . . Which Is for You? PAGE 144
PS gives you the lowdown on these yard aids, tells you what to look for. See also page 148

Two Basic Rooms You Can Add to Your House PAGE 162
Thinking of expanding your house? PS designs two modular add-on rooms that will match any architecture—you just vary the roof. Complete with blueprint.

How to Repair Your Toilet Tank PAGE 169
Sure, you can do your own plumbing work, in many cases. Here's the first article of a PS series—"Home-Plumbing Know-How"—to take the mystery, and high cost, out of repairs

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COMING NEXT MONTH

Are campers crazy? Or do they have more fun than anybody? Don't miss the heated debate between two famous writers, John Steinbeck and Erle Stanley Gardner, on the joys and miseries of vacationing in the great outdoors. Plus: How to Build an Expandable Camper (complete with a PS Lie-Flat Blueprint) . . . It Pays to Rent a Camper . . . and What's New in Camping.

In the same issue:

- Preview of the 1967 Indy 500
- A Midget Yard-Dozer You Can Buy or Build
- Norbye/Dunne Report on Two New Sportswagons
- "I Lived with a Computer—and So Will You"
- How to Cut Rabbet-Miter Joints
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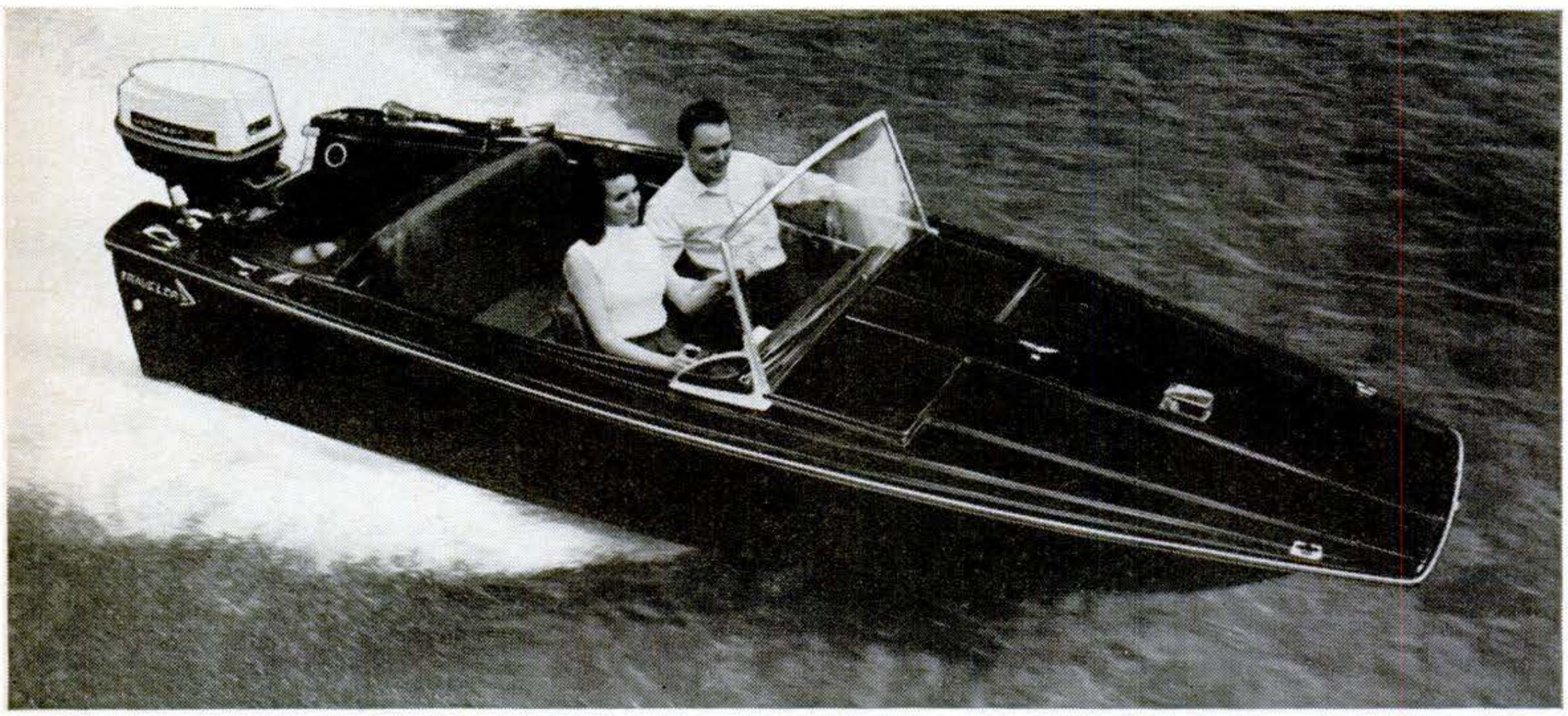

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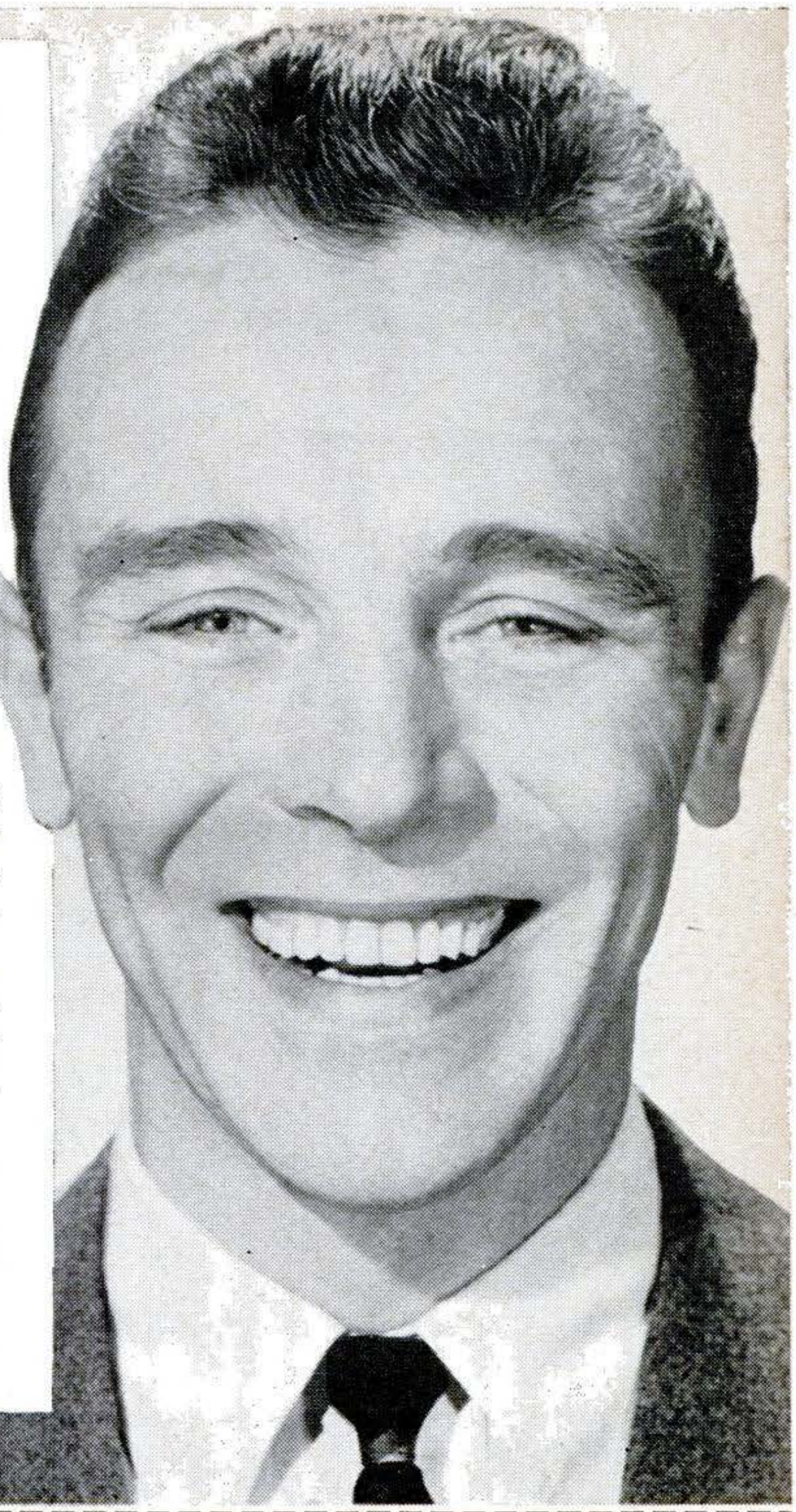
"Look who's smiling now!"



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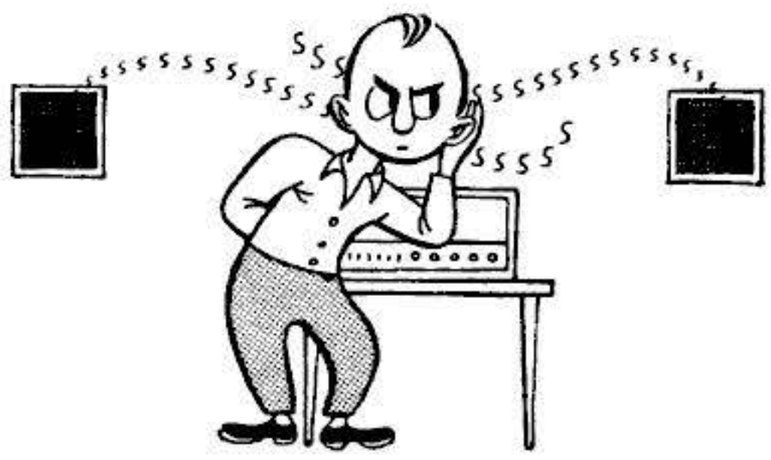
PS Readers Talk Back

Want to get something off your chest? Write "Readers Talk Back," POPULAR SCIENCE, 355 Lexington Ave., New York, N.Y. 10017.

TV and hi-fi gadgets

Your article, "Gadgets to Improve TV: Are They Any Good?" [Feb.] reported on the various gadgets that are supposed to improve TV and FM radio reception. I wish the issue had arrived just a few days earlier. It would have saved me money. My folks gave me a stereo radio for Christmas. Because of interference in



this area, there is a continual hissing noise across the FM band. A serviceman persuaded me to buy a rabbit-ears antenna for $7.50. I got more stations, but didn't lose the interference. Then I tried a plug-in filter. Another dollar wasted, because, just as you say, the gadgets have little effect.

REV. T. R. SEHLINGER, O.P., Dallas, Tex.

That hissing sounds like the classic symptom of a too-weak FM signal. It's possible that you have installed the radio in a steel-framed building, and not enough FM signal is getting through to the radio. Sometimes, defects of this sort indicate an insufficiently sensitive receiver.

. . . I am a gadgeteer and really appreciated your article. I installed a speaker killer, or as my wife and I call it, a "shut-up," to kill the terrible commercials. We have had it on our set for two years. You say the device *may* severely damage a set's sound system. It apparently hasn't harmed my set in the two years it's been on.

D. HEPBURN, Hyattsville, Md.

The key word is "may." Your set appears to be unaffected.

Andretti tests the Firebird

Is the Pontiac Firebird that Mario Andretti tested ["Pontiac Firebird: The GTO Gets a Little Brother," Feb.] the same as the Pontiac Banshee that I read about last summer? There seemed to be differences in styling and it didn't appear that the Banshee had the basic body of the Camaro as has the Firebird. Did Pontiac drop the Banshee completely?

BILL PHILLIPS, Richland, Wash.

The Firebird came out of Pontiac's Project Banshee, but it is not the same car as the original Banshee, which was dropped.

Fun cars you can build

I've been a PS reader for several years and commend you on your fine magazine. However, as a Jeep owner and enthusiast, I take exception to the fanfare over the modified Volkswagens in "Fun Cars You Can Build from a Kit" [Feb.]. The article says that parts from a junkyard plus a ready-made body produce a car that will "go anywhere a four-wheel-drive vehicle will go, with twice the comfort, almost twice the speed, and less than half the cost of a typical FWD." The phrase "go anywhere" is liberally used. Does Jim Wright think one of these expensive plastic and scrap creations could cross the Darien Gap? I'd prefer my 19-year-old Willys Universal.

PAUL CHAPLIN, South Burlington, Vt.

Skidding hazards

In "Stop Skidding! New Research Is Whipping Your Greatest Driving Hazard" [Feb.], you say only New York State has a statute on tire-tread thickness. Here in New Hampshire, we have a 3/32-inch minimum, checked at May and October inspections. Anytime you get caught in a routine road block with less than the minimum, you get a ticket and have to re-

place the tires. Any accident caused by poor tires is the driver's fault and he's stiffly fined.

A. CARON, Colebrook, N. H.

. . . Vermont also has a minimum tire-tread requirement which is rigidly enforced.

STANLEY D. SHORES, St. Johnsbury, Vt.

. . . Devon Francis is to be congratulated for his article on skidding. I would like just to mention one point which was omitted. Easterners coming out here think we are chicken-hearted when we reduce speed after a rain has wet down the freeways, instead of going at our usual fast clip. This was my reaction, too, when I first came to southern California. But then came my first experience with the California rain that follows a dry spell and my right front

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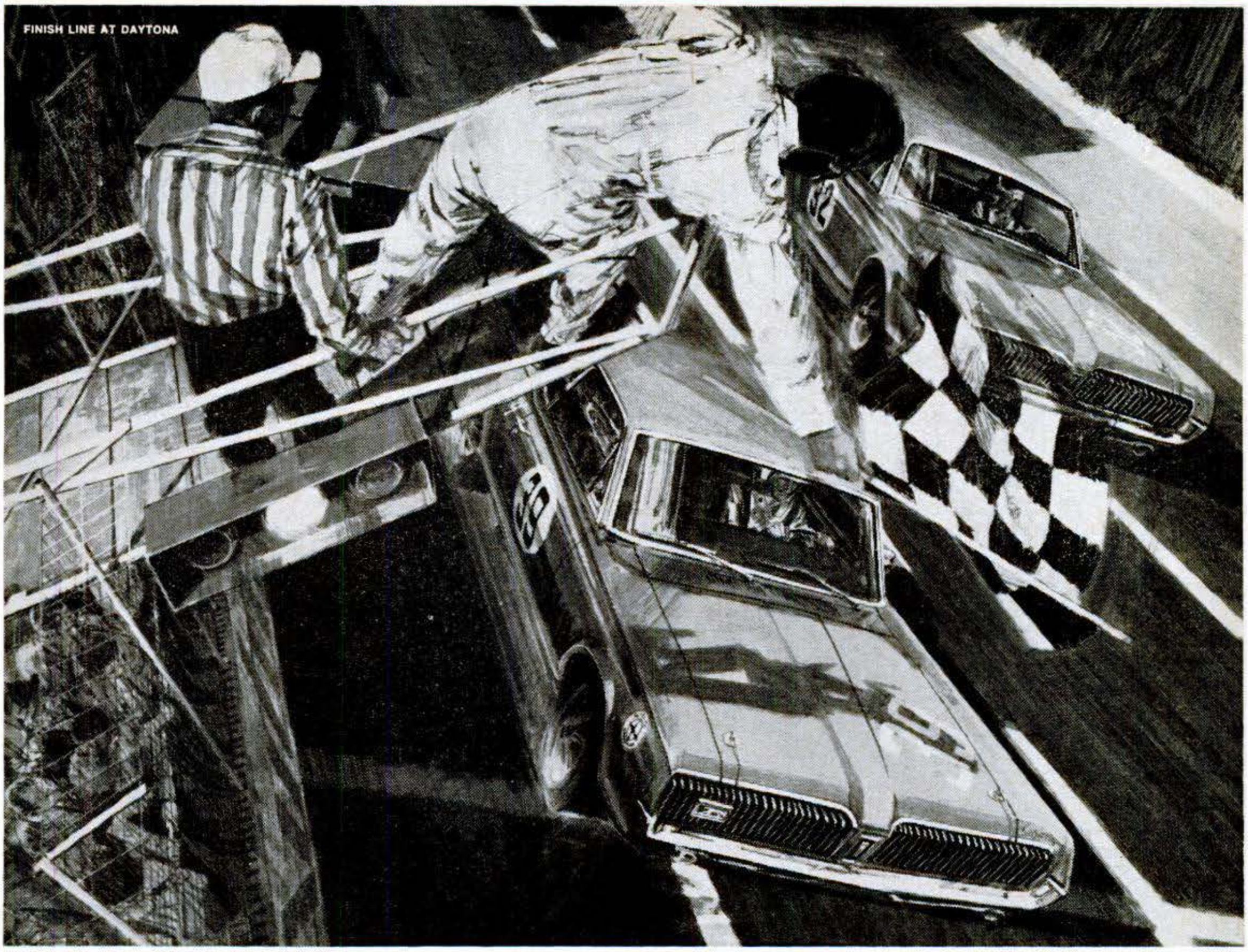

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MERCURY COUGAR

American. (Cougars to be raced will be powered by a specially prepared 289-cubic-inch V8 engine.) Following are specifications of the Cougar Group 2 from which the special version derives. Body style: two-door hardtop. Engine: Mercury overhead valve V8. Bore & stroke: 4.00" x 2.87". Displacement: 289 cu. in. Compression ratio: 10.5 to 1. Brake horsepower: 341 @ 5800 rpm. Torque: 300 lbs.-ft. @ 4000 rpm. Carburetors: two 4-barrel. Transmission: 4-speed synchromesh. Suspension: independent coil, front; leaf, rear. Brakes: double-caliper, vented disc, front; drum, rear. Wheelbase: 111". Overall length: 190.3". Curb weight: 3223 lbs.

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And that language is Ford *total* performance. Total performance knowledge requires participation in every phase of racing. So everywhere racing goes—Ford, and only Ford, goes. To Indy, Le Mans, Darlington, Riverside, Daytona, drag strips. And where Ford goes... Autolite goes. Designing, building, and testing new performance techniques. For Indy cars. For cars like the Cougar above. For dragsters. For stockers. For your car, too. Racing is the only road to high-performance know-how. And only Autolite has traveled every inch of it.

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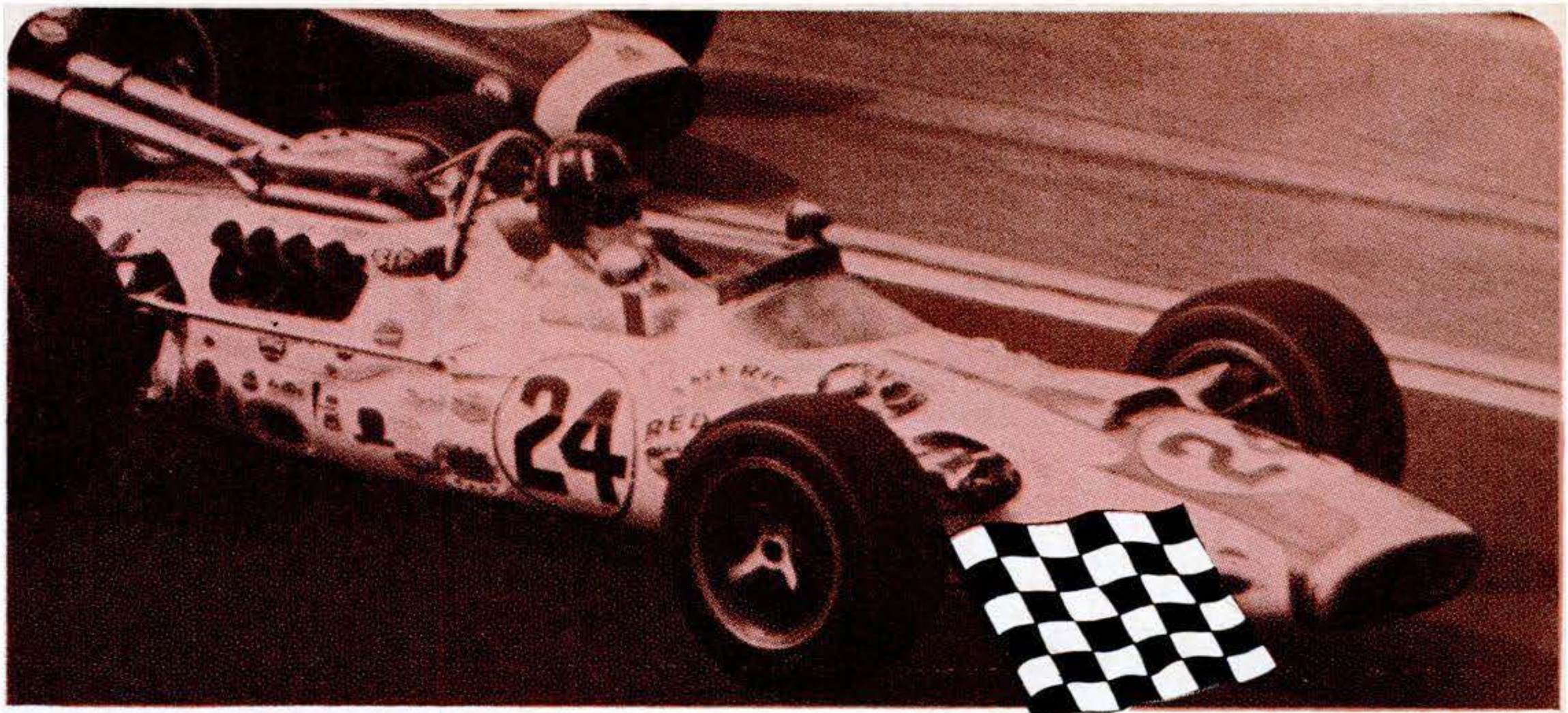
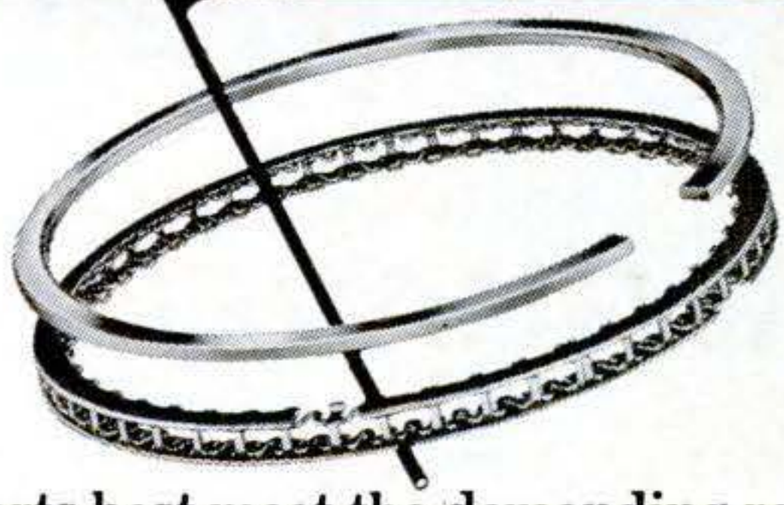


IT'S WIN, PLACE AND SHOW FOR PERFECT CIRCLE AT THE INDIANAPOLIS "500"



Talk about a clean sweep! 1st, 2nd and 3rd place winners at Indianapolis used Perfect Circle piston rings, valve seals and cylinder sleeves! What's more, every qualifier in the "500" used PC rings and valve seals. Coincidence? Not at all! It's solid proof that these vital parts best meet the demanding requirements of championship drivers. The PC piston rings, valve seals and cylinder sleeves used by the winners were standard parts—the same kind you can buy. Always insist on PC for *your* car . . . like the professionals do!

PERFECT CIRCLE

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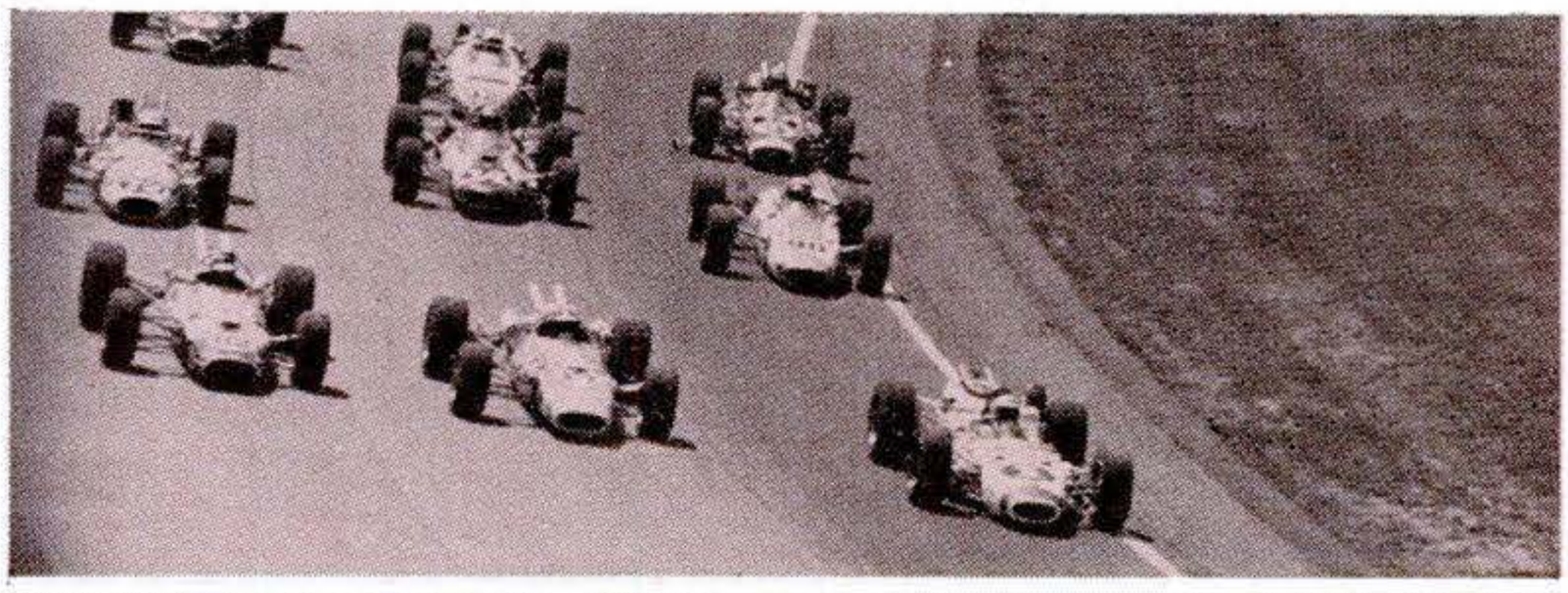

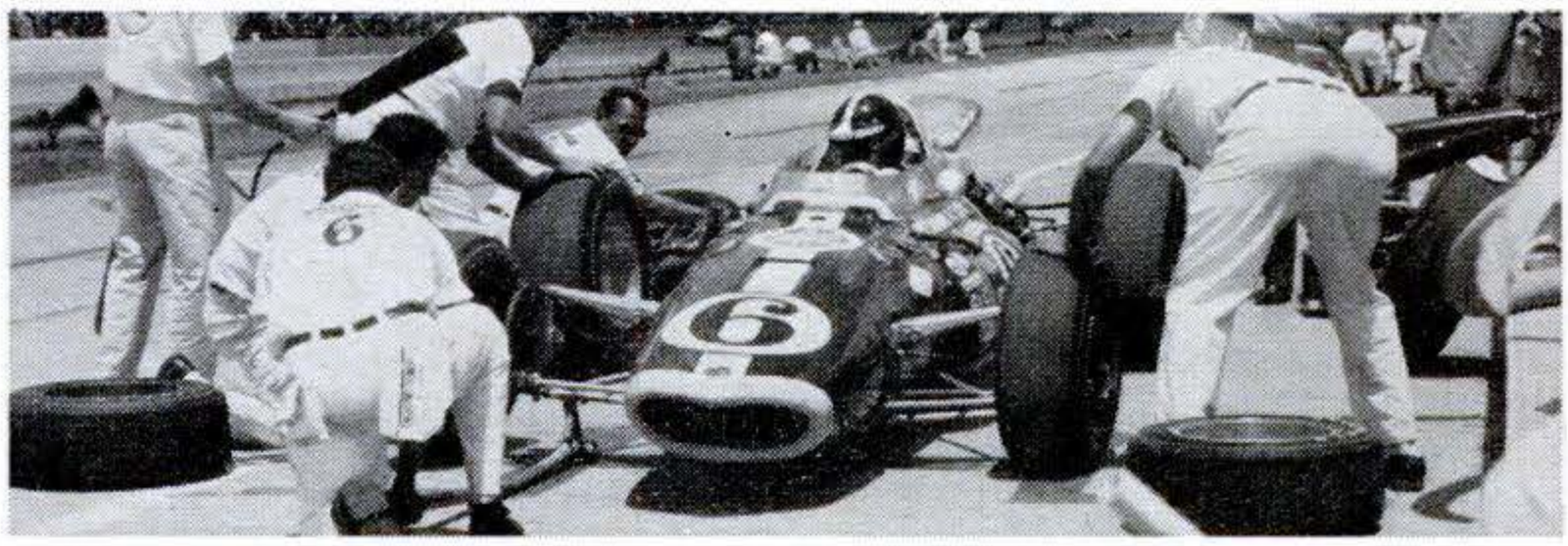

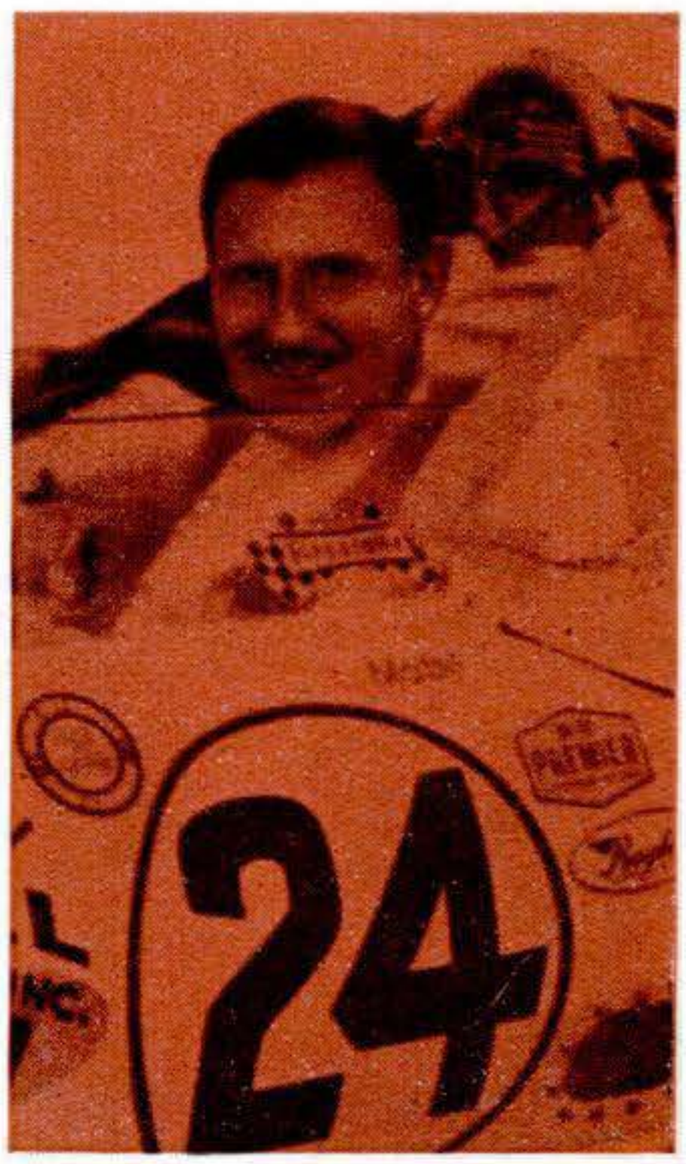

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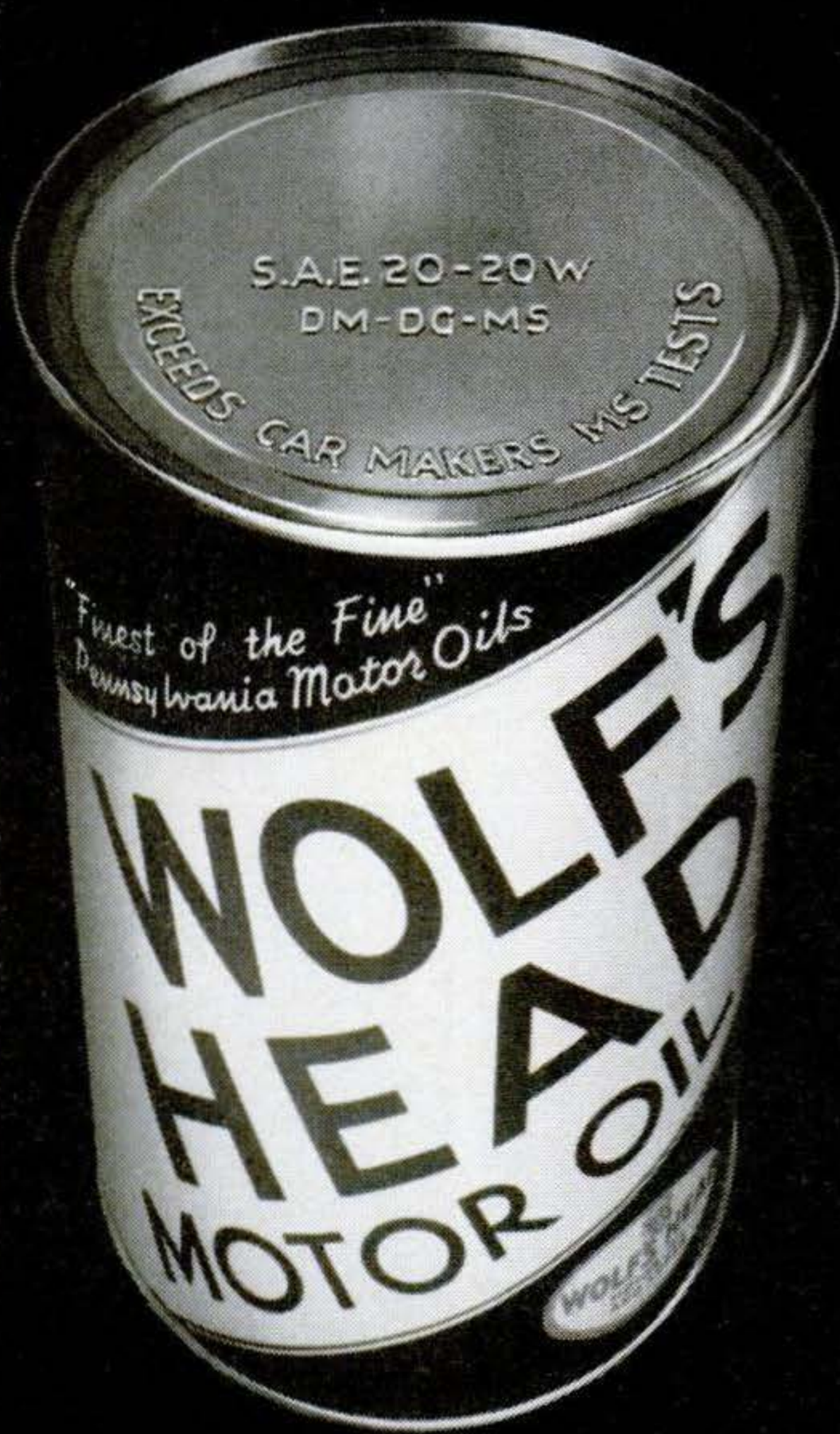
Buy your oil the way you bought your car. Carefully.



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PS Readers Talk Back

[*Continued*]

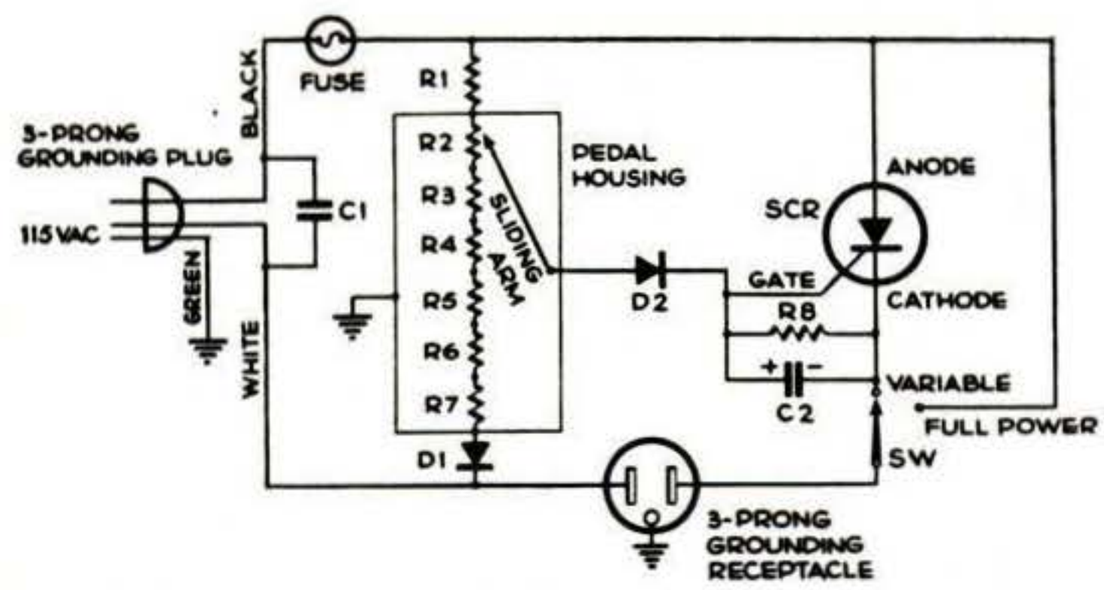
fender smacked a power pole. In southern California, where there is no rainfall during the summer, an oil film accumulates on the highways, which stretches from one side of the road to the other. Comes the first rain and it turns into an emulsion. The result—your car becomes a steeringless toboggan when you have to stop abruptly. Serrations will not relieve this hazard and might even aggravate it by collecting oil in the grooves, creating an even more effective emulsion.

Dr. Hans A. Rudolph, Los Angeles.

Project problems

Your magazine is one of my favorites, especially when it comes to the projects. I have built several and have found them to be excellent. I recently built the "Speed Control for Power Tools" [Feb.]. There was one problem, though—it didn't work. After some investigation, I found three serious errors on the parts list:

1. Capacitors C1 and C2 should be interchanged.
2. Resistors R2 and R8 are mislabeled.
3. D2 is shown reversed in the pictorial diagram. It should be positioned as indicated in the schematic diagram.



R8 is given as 100 ohms, but this is too low a resistance. It should be 1,000 ohms. R2 is given as 1,000 ohms, but this should be 100 ohms.

I made the above modifications on my circuit and found that the unit worked perfectly.

John L. Barberio, Little Silver, N.J.

Gremlins! Gremlins!

How fast does the world's biggest ship go?

The caption under the photograph of the world's largest ship ["Picture News," Feb.] listed the Idemitsu Maru's cruising speed as 6.5 knots. I think this should be 16.5 knots.

V. W. Bugg, New York City.

Right you are.

Moving a mountain

Your article "Dogsled Derby: Hills, Chills, Spills, Thrills" [Feb.] places Mt. Hood in

Continued

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Let's say you just bought a used car from a VW dealer. You're driving along a peaceful country road and the motor quits, the transmission drops out, the rear axle breaks and the electric clock starts to work. Don't worry.

Volkswagen dealers guarantee their used cars.

And the guarantee covers everything that makes a car tick.

So the engine, transmission, and rear axle will all be repaired or replaced free.

In fact, even if the electrical system shorts out, the front axle assemblies become unassembled and the brakes go out of adjustment on that peaceful country road, he'll repair or replace them free, too. Because he guarantees them all 100% for 30 days or 1000 miles. Whichever comes first.

If you know about used cars, you know this is the period when anything big that's going to go wrong with one will probably go wrong. Though nobody will be more surprised if it does than a VW dealer.

He completely inspects every car he gets as a trade-in. And anything that needs repairing or replacing gets repaired or replaced right then and there, before he puts the Volkswagen guarantee sticker on the windshield.

Just so you won't be misled, it doesn't have to be a Volkswagen to rate the sticker. You'd be surprised at all the big cars people trade in just to get their hands on one of our little ones.

Big or little, any trade-ins with a guarantee sticker on them already have some of the dealer's money in them.

Enough for him to want to be really sure the one you drive away in isn't going to come back and cost him more.

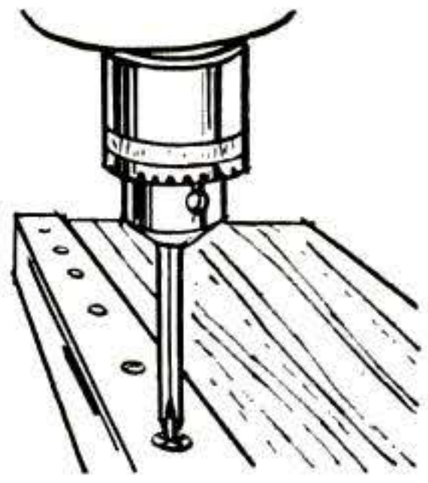
But if it should, (1) it's always nice to know you do have a place to bring it back to, and (2) better him than you.

This car has passed our 16-point safety and performance test.

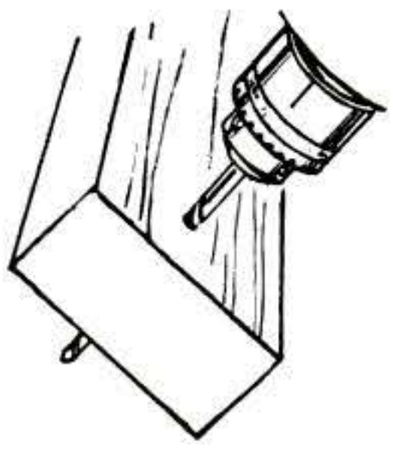
Look for this sticker and you won't get stuck.

© VOLKSWAGEN OF AMERICA, INC.

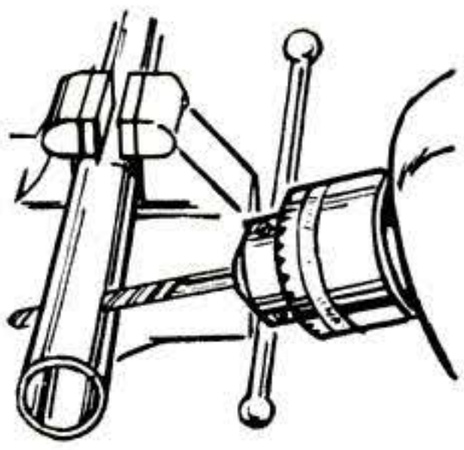
Controlled speed. *You can use your Variable Speed Drill to mix paint in any size can and never slop or splash.*



Great for screwdriving. *Simply use slow speed to start screw. Speed up by squeezing harder until screw is tight.*



Drill in wood *as you do with any drill, using higher speeds. The same bits used for metal can be used for wood.*



Drill in metal *without center punching! You can start slow enough to drill into a rounded surface with ease.*

New ¼" Variable Speed B&D Drill gives you true workshop versatility.

Use a Black & Decker Variable Speed Drill for a new experience in workshop versatility. This ¼" Deluxe double-insulated model lets you squeeze any speed from 0 to 2250 rpm. Mix paint without splashing, start a drill bit on rounded metal, drive screws—do jobs ordinary drills can't do. For a limited time, Black & Decker includes two screwdriving bits for the $29.99 price of the drill alone: one for slotted, one for Phillips head screws. Save $2.65. See the selection of Black & Decker drills at your nearby dealer's, or write Black & Decker, **Dept. C-0477** Towson, Md. 21204.

B&D

PS Readers Talk Back

[*Continued*]

Washington. Oregon will take a dim view of this. We have several high mountains in Washington, but not Mt. Hood.

GORDON K. POTTER, Walla Walla, Wash.

Mt. Hood is indeed in Oregon, but maybe on a clear day you can see it from Washington.

PS discoverer

The January issue of POPULAR SCIENCE was the second I've purchased. The December issue was a discovery for me and I wondered if two in a row could be as good. The January issue is better. Congratulations on having one of the finest and most informative magazines.

JOHN A. DALTON, Douglasville, Ga.

Whatever happened to the Baylin engine?

Your roundup of the RC engines ["Rivals to the Wankel," Jan.] did not mention the Baylin engine. I have not seen anything in print concerning the Baylin since 1946 (it was covered in PS, July '46). It was the product of a Canadian named Sam Baylin and was perhaps the most simple gasoline engine. It had only three moving parts and at that time claimed one horsepower per pound of weight. Do you have any knowledge as to what happened to it?

C. C. FERGUSON, Wilmington, Del.

Can any PS readers bail us out on the Baylin engine?

Are You Moving Soon?

TO CHANGE YOUR ADDRESS or to enter a subscription (at 1 yr. $4, 2 yrs. $7, or 3 yrs. $9) mail this form to: Robert Harlan, POPULAR SCIENCE, P.O. Box 1083, Boulder, Colo. 80313.

ATTACH LABEL HERE — If you are planning to move, please notify us 6 weeks in advance and we'll make sure your subscription moves with you. Please use this form and attach your magazine label.

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TOM McCAHILL SAYS:

"Good Appliance Repairmen are Scarce as Edsel Dealers!"

I don't think anything disturbs me as much as trying to find an appliance repairman . . . and finding out I'll have to wait my turn because he has more business than he can handle.

With over 400 million Appliances now in use, and more coming every year, there just are not enough repairmen around to take care of every Mrs. Jones who wants a broken Appliance mended in a hurry! And that's why a smart guy could really clean up in the Appliance repair field.

Some years back, almost anyone could do a fast repair on an iron or toaster with a bit of fancy tinkering. But today's complicated Appliances call for a special brand of know-how the average Joe doesn't have without training. Appliances are loaded with thermostat controls, solenoids, and special devices. Unless a repairman has a working knowledge of these parts, he won't even get to first base.

That's why I want you to take a good look at the home study course offered by the Appliance Division of the National Radio Institute. They show you all about repairing home and commercial Appliances—even farm Appliances and small gasoline engines. If you're interested, they also include a special package covering air-conditioning and refrigeration repairs. The cost is surprisingly low, and even includes a special Appliance Tester.

NRI is one of the biggest and best schools in the field, and has been around since 1914. They have a staff of 150 people in Washington, D.C., who are equipped to guide you through the easy course with expert and personal instruction.

Take it from Tom . . . this is one of the easiest and most rewarding fields a guy can enter today. You don't need a college education, you don't even need to know the first thing about Electrical Appliances when you begin your training.

There's nothing to lose . . . except the price of a stamp on your letter or postcard. Fill out the coupon below *now*, before you turn the page. Get the full rundown on the training that can increase your spare time income or provide you with a business of your own a lot sooner than you think. In just a few short months you could be ready to take the first profitable step towards a new and rewarding career. Do it!

Tom McCahill

TOM McCAHILL

APPLIANCE DIVISION, NATIONAL RADIO INSTITUTE
3939 Wisconsin Avenue, Washington, D. C. 20016

AVAILABLE UNDER NEW GI BILL.
If you served since January 31, 1955 or are in service, check GI line below.

601-047

OK—I want to see for myself. Send me the free book on Professional Appliance Servicing. No salesman will call.

Name_____ Age _____

Address_____

City_____ State_____ Zip Code_____

Accredited Member National Home Study Council.

☐ Check for facts on new GI Bill.

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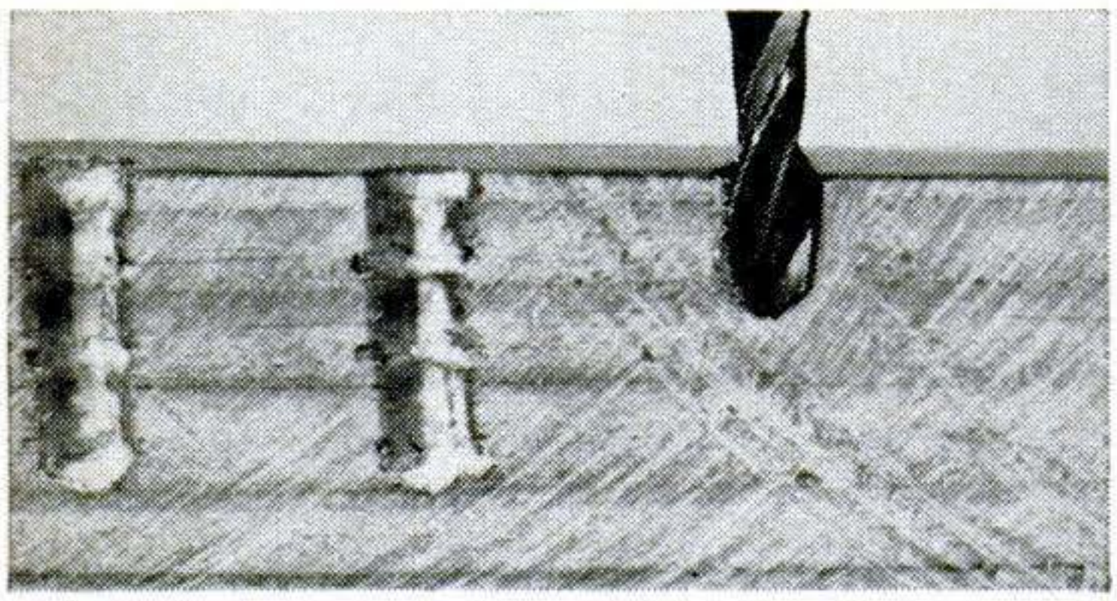
Seven workshop headaches. Seven Mystik Tape Cures.

1. Drilling a Finished Surface:

When you're drilling a finished wood surface, the drill can skid out of the punch and scar the finish. You can avoid this by sticking a piece of Mystik Clear Plastic Tape over the spot you want drilled. This skidproofs the surface. So you won't have to worry about damaging the finish.



2. Removing a Tap Washer Without Scratching the Chrome:

When you're changing a faucet washer, wrap the chrome packing nut with Mystik Electrical Tape. You'll avoid scratching the nut with the wrench.

3. Keeping Wood From Splintering When Sawing:

A strip of Mystik Masking Tape placed on the underside of the wood, along the cutting line, will keep the edges from splintering while you saw. (This is especially helpful when you cut plywood.)

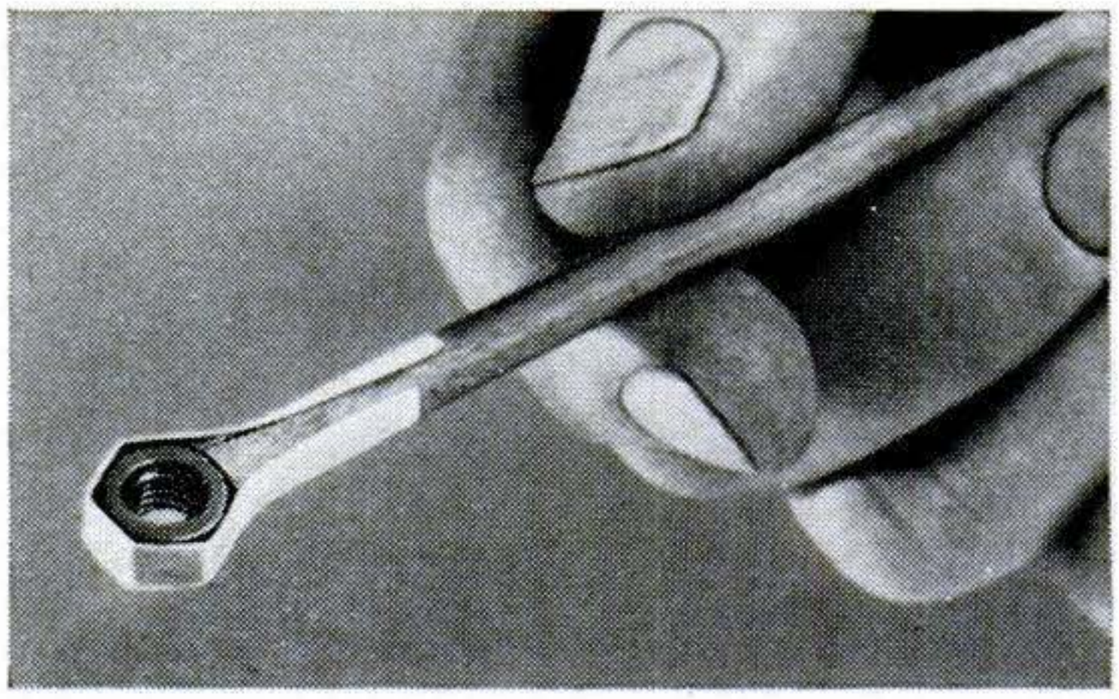
4. Losing Small Parts:

Mystik Double-Faced Tape makes a great no-spill parts rack when disassembling and reassembling a small motor. Stick a strip of the tape on your bench and press the parts on it in the order of disassembly. This makes reassembly easy.

5. Tools Without Handles:

If you don't have handles for all your files or hacksaw blades, wrap Mystik Electrical Tape around the tangs, and you'll fashion a working handle.

6. Threading a Nut To An Inaccessible Bolt:



If you have to thread a nut and bolt in a place you can't reach with your fingers, cut a piece of Mystik Masking Tape (as wide as the nut is thick) and use it to mount the nut on the end of a pencil, butting the side of the nut to the pencil. This way, you can hold the nut in place while you turn the bolt into it.

7. Holding Tacks on Hand-Tool Heads:

If you're working with small tacks, place a piece of Mystik Double-Faced Tape over the hammer head. The tack will stick easily to the tape. You can then give the tack a firm, direct hit.

BORDEN CHEMICAL

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Cadet is for keeps!

Most men have about 18 hours a week when they're not working, commuting, sleeping or doing the routine "chores" of living. Just 18 hours a man can call his own. And they're yours just once. Irretrievable. Make your own golden hours more fun, more free and more productive with an International Cub Cadet® home tractor. Four models—gear drive with 7, 10 and 12 hp, or 12 hp hydrostatic transmission. Cadet's no toy; it's a tractor—built like the bigger IH tractors.

Can you afford to keep on replacing cheaper machines?

12 hp Cadet with 48″ rotary mower. Also works with front and rear blades, rake, snow blower, rotary tiller, box scraper and dozens of other year-round attachments. To find your nearest Cadet dealer, phone Western Union and ask for Operator 25.

® International Harvester Company—the people who bring you the machines that work

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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in POPULAR SCIENCE Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.

Smokey talks fast with his driver, Curtis Turner, during pit stop in stock-car race.

"I have a 1966 Volkswagen 1300. Could you tell me if it is better to downshift rather than just brake on a hill? Is downshifting too much strain on the clutch?"

E. J. HALL, Vancouver, B.C.

Do both. Baby it until you get the feel of it. Be kind. The car is a little weak in the gear department.

"I hear pros and cons on ventilated vs. unventilated distributor points. Which would be best for my '63 Chevrolet, and why?"

BOBBY BATTEN, Thomasville, N.C.

You sure asked a man with experience on this one! I lost a $25,000 race once because of vented points. Stick to what Delco-Remy made for those babies. I wish I had!

"After doing 70 m.p.h. for about a half-hour, my '63 Chrysler Newport (361-in. engine and air conditioning) overheats, though it runs fine at 60. I had the cooling system cleaned, the radiator rodded out, put on new hoses, water pump, and pressure cap, and had the engine tuned and timing checked. It still overheats, and the antifreeze bubbles up and foams."

GERALD BISHOP, Chicago.

You get E-for-Effort, but check some more. On a cold engine remove the water pump, belt, and thermostat. Have the radiator filled to the top of the thermostat housing, and have someone run the engine under some load (in gear, with the brakes on) while you watch the water. If you see bubbles, it means leaking gaskets or heads. See that the exhaust system is open and normal. If that A/C was added after the car was built, check for a possible restriction of air through the engine compartment.

"My '63 Pontiac (389-in. engine and automatic transmission) has an automatic choke that refuses to engage at first start in the morning when the accelerator is depressed. Only when I tighten up the choke spring tension excessively on the rich side will it engage. Replacing the entire choke assembly didn't work, either. All parts work freely when manipulated by hand."

DR. V. W. WHITNEY, Tampa, Fla.

This is not a real tough job, but it has to be done right. Go to a Pontiac dealer or a carburetor specialist and have it done "by the numbers." I'll guarantee you—it'll work.

"Ever since I bought it, the six-cylinder engine in my 1965 stick-shift Chevy II has idled rough. The dealer has worked on it several times to no avail. I've tried new points, plugs, and carburetor overhaul. The factory-service rep says the engine is just a 'rough idler' like all Chevy II sixes. I don't believe that."

HARRY WHITMAN, Merriam, Kans.

Neither do I. Your idle is rough because the mixtures in all the cylinders aren't the same. The cure is to get a sharp mechanic who will take the time and trouble to pin down the lean and the rich holes. When he spots them, he can experiment with the plugs, timing, carburetor jets, and everything else on the intake side until your car purrs at idle—and it should.

"Last spring I decided I would drag race my new Morris 850 just for laughs. I had my service station install a straight pipe, even though they claimed it would cause warped valves. I now drive it often on the street with the pipe open. Can this be harmful? If so, why do many racing engines run straight pipes?"

BOB SWITZER, Edmonton, Alta.

Valves warp usually from getting too hot, from uneven temperatures at valve seats, or

Continued

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Balanced AC Spark Plugs prove one thing...

Automotive engineers know that for the best performance and economy in the kind of all-around driving you do every day . . . a *balanced* spark plug is needed. ACs are balanced to meet your every driving demand . . . cold starts, city traffic, stop-and-go, hill-climbing and turnpike-cruising.

That's why engineers specify *balanced* ACs for all new Chevrolets, Pontiacs, Oldsmobiles, Buicks and Cadillacs. That's also why they're best for your kind of everyday driving, no matter what make car you drive.

Next time you change, ask for AC Fire-Ring Spark Plugs, the *balanced* spark plugs.

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AC SPARK PLUG DIVISION

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from cooling very rapidly on one side only. Race-car engines use better materials and are less affected by temperature change. I don't say it's harmful, but it could be. Did you know that the better race mechanics plug the exhaust pipe some as the engine is shut down?

"At times, especially at high altitudes, my '66 Ford Econoline Supervan, with the 150 hp. engine and three-speed stick, lacks the power to pull my boat and trailer up steep launch ramps. Is there a four-speed box I can interchange without linkage problems? Could gear ratios be changed in the first-gear-reverse cluster only?"

ROBERT BENGSTON, Reseda, Calif.

It would probably be very expensive and a big job getting linkage hooked up for a four-speed. I suggest a very low rear-end ratio and an overdrive three-speed box for the least trouble and expense.

"Would there be any advantage in using an additive in the high-grade multiviscosity oil in my '64 Galaxie? It has 30,000 miles on it. I change each 4,000 miles—oil and filter—and burn about a quart each 2,000. The PCV system is in good shape."

PHILIP E. BRUBAKER, Texas City.

The major oil companies already have added to their premium oils all the chemicals that will do any good for engines in the condition yours is in. You need no purgatives or pink pills.

"The brakes on my '65 Olds Cutlass, with power steering and air conditioning, are not too effective above 50 m.p.h. Also, I have just installed new lower-front ball joints and heavy-duty shocks, and the ride is still bouncy. How can I improve braking and handling?"

NICHOLAS R. CECIRE, Newark, N.J.

Get new premium-type linings installed, and have wheel cylinders and brake drums put in good shape. Have the brake people tell you how to break in the new linings. To your heavy-duty shocks, add low-profile, wide-footprint tires and a police suspension kit from Oldsmobile.

"My '64 Falcon Sprint (260-in. engine, 164 hp) pings on regular gas, no matter how far I retard the spark. Premium gas does prevent it. Switching gas brands doesn't help."

GORDON WOLFORD, Yuma, Ariz.

First, check the distributor advance. If that's okay, pull the heads to see if you're not loaded with carbon.

"My VW 1600 burns up its points and plugs within 8,000 miles, and within 200 miles after

Continued

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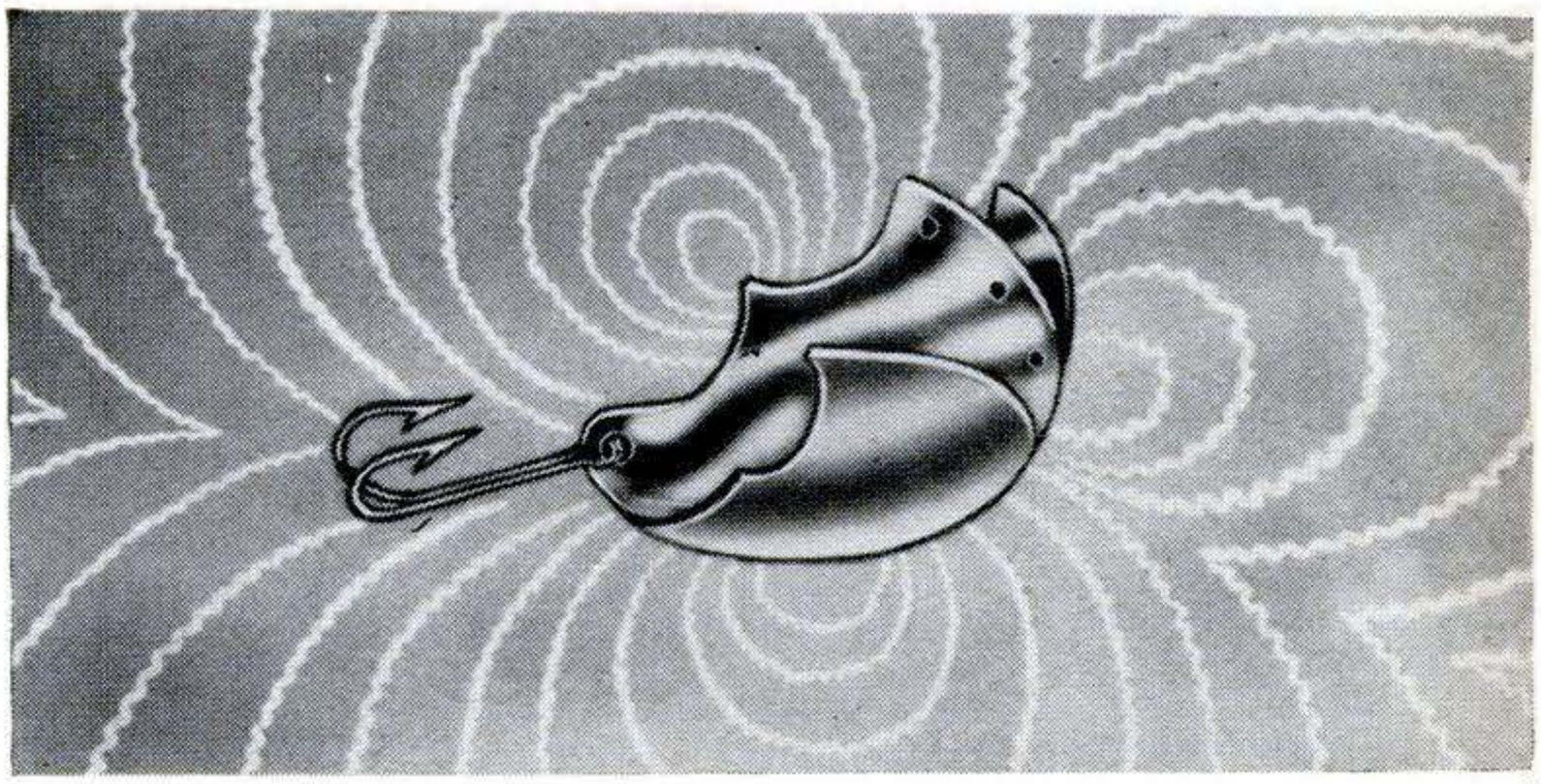
Weird New Sonic Lure Caught Fish Like Crazy!

Think of it! My new vibrating lure gives loud, gurgling, splashing, bubbling sounds as you skitter it along the surface of the water! Sends out up to 200 vibrations every minute underneath that water! Looks completely unlike anything that a fresh water fish has seen before.

And has already used this weird sight and weird sound and weird sonic vibrations—in one of its very first Summer trials—to lure fish into attacking it so savagely that they actually knocked it out of the water. Hauled in trout, bass, muskie, walleye, and pike, even when other lures had caught little or no fish right next to it! Here's why—



THIS IS AN ARTIST'S CONCEPTION OF THE VIBRA-BAT LURE AND IT'S SONIC EFFECT UNDER WATER! I believe it to be irresistible to fish! Try it entirely at our risk!

CAUGHT! 120 FISH IN ONE HOUR!

At Cattail Lake, Illinois, on August 20, 1961. A hot summer day! A beautiful stream-fed pond—90 by 60 feet wide! Fishermen trying lures, flies, natural bait! But there is only an occasional strike. It looks like a wasted day!

Then, three die-hard friends try their luck with me! We cast from the edge of the water. At the end of our lines is an entirely different lure—a weird little metal monster that casts like a bullet and flutters back through the water like a drowning bat!

EXPERIENCED FISHERMEN SURPRISED

Almost at once that quiet water explodes into action! The first strike causes a shout of excitement! And then a second strike! A third, fourth, sixth, seventh, eighth! Beautiful rainbows and browns still shimmering from the water—being pulled in at the rate of more than one every minute!

Meet Lyman Walton, a direct descendant of Isaac Walton and co-inventor of the amazing VIBRA-BAT LURE.

Now the water almost explodes with fish striking! Sometimes four and five trout savagely attack one lure at the same time! Fifty—seventy—ninety fish are caught and released! People along the shore stop to watch!

In one short hour, we have caught and released 120 fish! All with the very same weird little lure that can go to work for you next week, without risking a penny!

Why did this bat-shaped lure catch fish by the stringer-full—even after ordinary lures, and natural bait have caught little or nothing? For this simple reason—

Because this lure gives off unique gurgling, bubbling, splashing surface noises—plus up to 200 sonic vibrations every minute underneath that water—that fish find irresistible!

Navy Fish Biologist report about the sounds fish make between themselves in the water. Fish follow the propellers of a boat as though they were hypnotized by the sound!

Those gurgling, bubbling, splashing surface sounds and underneath vibrations—actually seem to call fish to them. Research showed me that lures, like fish, create Sonic Vibrations in the water by their movements! So I designed a lure that flutters through the water up to 200 times a minute! Wing-shaped—bat-like—jerking and fluttering madly through that water—sending out irresistible sonic waves—gurgling, splashing, bubbling surface sounds that travel through water in every direction at the rate of 4,760 feet every second, the actual speed of sound under water!

READ THESE FISHCATCHING ACHIEVEMENTS

No wonder this "VIBRA-BAT" lure caught a 10 pound 7½ ounce Northern on one of its first tests—only moments after it hit the water—hauled in six bass in sixty minutes in another test, all 2½ pounds or larger—pulled in perch by the dozens in a third test at Belmont Harbor, Illinois, even after live bait and lures had scarcely a strike, and continued to land so many fish, so quickly, that fishermen watched in amazement!

Tests show this revolutionary new lure hauls in trout, bass, muskie, walleye, pike, salmon and other fresh water fish even in hard fished waters—produces strikes even when other fishermen alongside it are going almost unrewarded!

AMAZING 6-MONTHS TRIAL OFFER

You simply cannot believe the fishcatching powers of this amazing lure until you try it yourself. For 6 full months entirely at our risk! We cannot guarantee, of course, that these amazing VIBRA-BAT SONIC LURES will produce for you in every pond, river or lake everytime you go fishing but we do guarantee that these VIBRA-BAT LURES will definitely catch more fish for you... make you agree that this is the greatest little lure you've ever used—or simply return them anytime within six full months for every cent of your purchase price back!

You and you alone are the only judge! You have nothing to lose! Send in the Six Month Trial Coupon TODAY!

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MAIL MONEY-BACK GUARANTEE COUPON TODAY

SPORTSMAN'S LURES, Dept. PS, 488 Madison Avenue, New York 10022

Enclosed is check or m.o. for $_____

Rush me _____ VIBRA-BAT LURES @ $2.98

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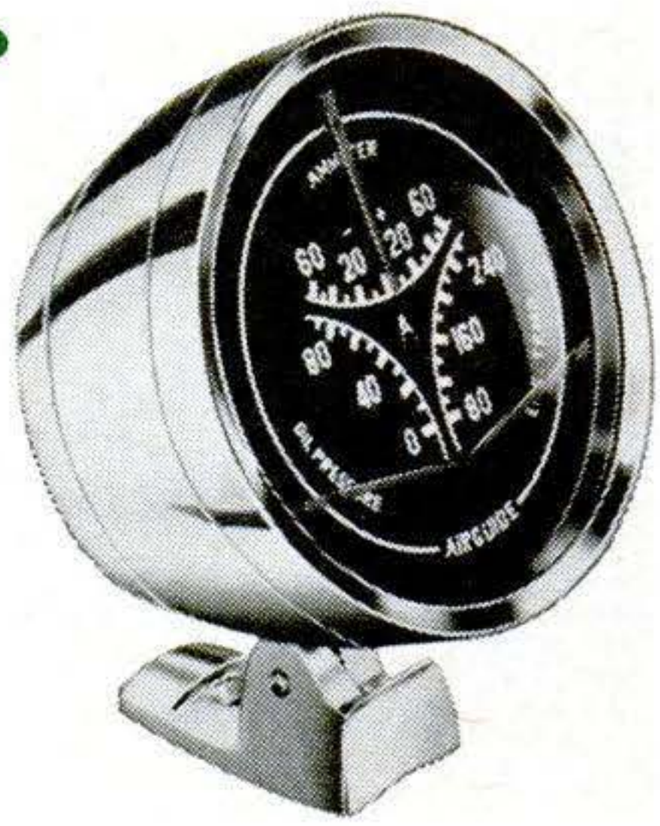
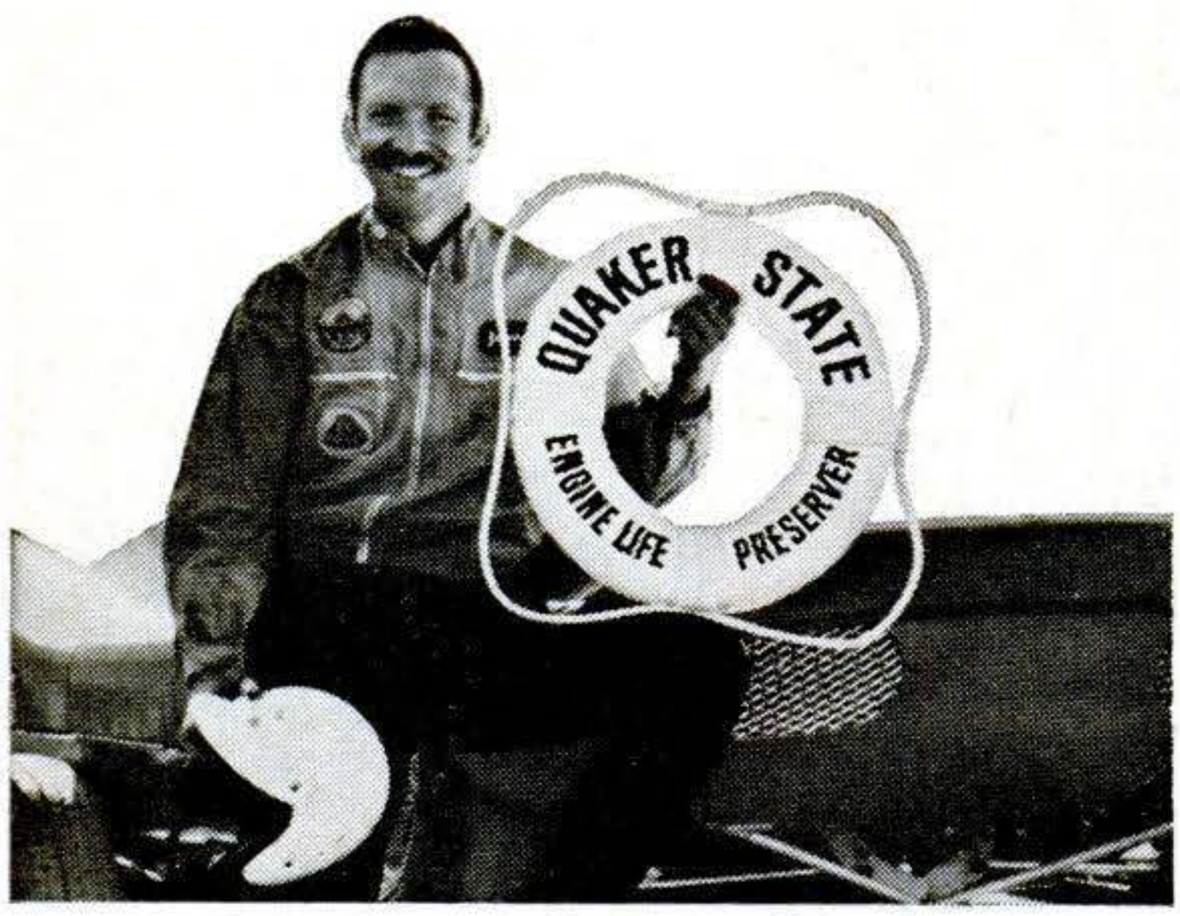
Test your automotive I.Q.



This compact unit indicates_____?



What does this symbol stand for?

Separate needles show oil pressure, water temp, and battery charge rate. The symbol is the engine life preserver, which means Quaker State Motor Oil. Refined only from 100% Pure Pennsylvania Grade Crude Oil, the world's choicest, Quaker State keeps engines cleaner, quieter, more powerful. It reduces engine wear, keeps your car running young. Ask for Quaker State—the very best engine life preserver you can buy.

Quaker State Oil Refining Corporation
Oil City, Pennsylvania

"Say, Smokey—"

[*Continued*]

a retune it begins to miss on takeoff. Will a transistor ignition correct this?"

RICHARD CHERNEY, Battle Creek, Mich.

Start from scratch. Get a thorough analysis of your engine. Check the rings, valves, gaskets (for leakage), and the intake system. Have a voltage check made on storage and delivery to the coil and distributor. I see no reason for a transistor ignition. Oh, yes—see that no oil is getting to your points.

"My '65 Buick Le Sabre with 24,500 miles on it and oversize 8.45-by-15 tires vibrates in the rear at over 63 m.p.h. The tires have been trued and balanced dynamically. Drive shaft, pinion and rear shocks are okay. Can you offer any suggestions?"

MELVIN R. MYERSON, Rockville, Md.

Whew, this will take some doing. It's liable to cost you money. For the least cost, see that you have the latest engine mounts. Experiment with tire pressures, even different tire brands. For that, if you have a friend with a car like yours—that doesn't vibrate—borrow his wheels and tires and try them out. If they work, you're in. A final thing: Sometimes tires, body, and frame resonate together at about 65 m.p.h., and this can be traced to body mounts. I believe there are some newer body mounts that might help—if that's your trouble.

"The overdrive on my '62 Rambler Classic cuts out after driving a few miles. When it was checked out, they told me it must have a short somewhere, but they can't find it."

ANTON L. BROTZ, Chelton, Wis.

Have a good automotive electrician check for defective wiring and current flow. It could be the governor or solenoid. Worn parts can force the solenoid back out, causing the drive to go back to straight line.

"I bought a 1959 Imperial and would like to use regular gas in it rather than the high-test called for. Is it possible to 'tune down' the compression ratio of this engine?"

O. C. JOHNSON, Buffalo, N.Y.

No. Stick to high-test. More is involved in "detuning" an engine than compression ratio. It could mean other, expensive changes. Even then your car probably would be no more economical.

Got a question on autos? Send it to:
"Say, Smokey—" POPULAR SCIENCE
355 Lexington Ave., New York, N.Y. 10017.
Not every question may be used. Questions cannot be answered by individual letters.

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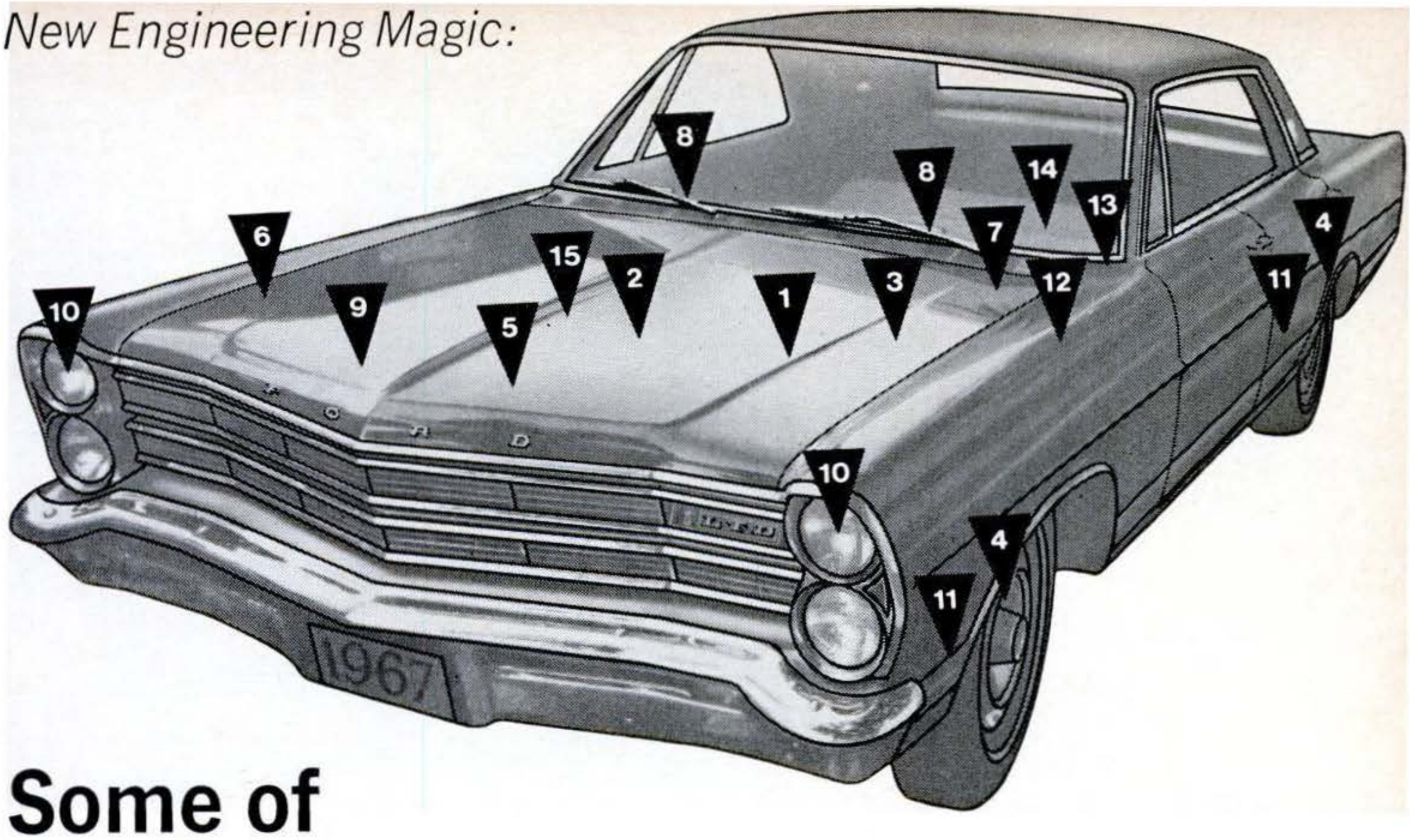

Some of our better ideas are INVISIBLE...

Here are 15 of them . . . all designed to make your Ford stronger and more durable than ever.

There are over 15,000 separate parts in each new Ford. But it's unlikely that you'll ever see more than about 5% of them.

However, it's the constant improvement of the thousands of unseen parts that concern most of Ford's 7,000 engineers. Because on the performance of these parts rests the reliability, quality and long-lived durability of every Ford.

That's why with each yearly model change—and often in between—hundreds of hidden parts in every Ford are strengthened and improved. Here are 15 typical examples of the many improvements that have been made in the '67 Ford.

1. Clutch—Improved release bearing and spring seats. This change means longer life and smoother operation.

2. Piston Rings—Rings filled with moly-disulfide decrease cylinder wall wear and increase oil economy.

3. SelectShift Transmission—New bands give consistently smoother and more even shift performance.

4. Wheel Bearings—New seals and grease to increase long life.

5. Distributor—New, pivotless-type contact points increase longevity.

6. Voltage Regulator—Improved in precision of control by better calibration and a new ballast resistor.

7. Speedometer Cable—Improved routing, fitting and mounting of the speedometer drive cable and a new high temperature lube for quieter action and longer life.

8. Defroster—A new design gives greater reliability.

9. Alternator—Molded circuit board for greater durability.

10. Head Lamp Mountings—Redesigned for increased stability—longer "in focus" time.

11. Brakes—Self-adjuster mechanism redesigned for more accurate self-adjustment of the lining.

12. Parking Brake—Redesigned cable mechanism for easier operation.

13. Turn Signals—New, more durable switch.

14. Fuel Gauge—New contact design for longer life.

15. Carburetor—The float and needle valve assembly for V-8 engines has been redesigned to help prevent flooding and to aid driveability.

It's a continuous flow of improvements like these that make Fords so dependable and durable. And it's improvements like these throughout the car that enable us to say that the 1967 Ford is quieter because it's stronger, and stronger because it's better built.

You're ahead in a Ford

FORD

Mustang • Bronco • Falcon
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Science Newsfront

Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON

Automatic car has single control

Test-driving a car that steers, accelerates, and brakes with a single stick control (T-shaped device at center) are crash-helmeted Ohio State University researchers. The 1965 Plymouth carries a small digital computer in its trunk that responds to stick movements and controls the car's movements. The work, under the direction of Dr. Robert L. Cosgriff, director of Ohio State's Communications and Control Systems Laboratory, is aimed at producing a fully automatic computer-controlled car that will drive itself without a human overseer.

Life in outer space

Does life exist on other planets? Where would it come from? The answer may lie in drifting space dust, which one scientist claims to have identified. The dust is actually chlorophyll, a key compound of life on earth, which could conceivably reach the surface of other planets and there, through photosynthesis, produce at least simple life forms. The discovery of chlorophyll in space is the work of astronomer-physicist Fred M. Johnson of Electro-Optical Systems, Inc. The key to the puzzle came when he discovered that chlorophyll had the same optical properties—the same spectrogram—as space dust.

Electric power from refuse

With the development of rockets that run on garbage ["Science Newsfront," Mar.] city planners—New York among them—are eyeing refuse as an ideal fuel for large power plants. The heat from garbage incinerators is now completely wasted. By using it to generate power, the cost of garbage collection could be at least partly subsidized. Other advantages: Garbage contains less sulfur than the fuel oil currently used, and would produce less air pollution. Last, up to 98 percent of the smoke and odor can be removed.

Somersaulting signs cut auto injuries

A new type of roadside sign that somersaults right over your car when you collide with it is being developed by the Texas Highway Department and the Texas Transportation Institute to reduce collision damage to cars and their occupants. The experimental signs are supported by a metal slip joint mounted on a 20-degree incline at the base. When a car bumper strikes at speeds of 25 m.p.h. or above, the sign slides out of the joint and is given enough upward momentum to flip completely over the car. Maximum damage, even at speeds up to 60 m.p.h.: dents in bumpers, grilles, and hoods.

Chaff emergency flare alerts rescuers

A hand-launched rocket that carries radar-reflecting tinfoil strips (chaff) high into the atmosphere may be made standard equipment on all planes and ships, even small boats. Developed by National Engineering Science Co., the small rocket-propelled flare climbs 2,000 feet into the atmosphere and ejects its chaff, creating a cloud that can be seen on radar scopes hundreds of miles away. An important advantage: The chaff decends slowly, at about 40 feet a minute, providing a radar target at the site of a shipwreck for at least half an hour.

Can a skyscraper collapse?

What's the chance of a modern skyscraper buckling and collapsing in a huge mound of rubble? Ironically, the chance is somewhat greater today due to the use of high-strength

Continued

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CATCH MORE BASS and BIGGER BASS

...Return to the Dock with Plenty of BIG Bass Even on Days Other Fishermen Come Back "Skunked"

Jason's friendly, sincere and helpful way of counseling has caused even starter fishermen to catch more and bigger bass than they ever caught in their life before.

That's why arrangements have now been made to offer LUCAS ON BASS on a remarkable six month trial basis as described below.

How'd you like to take a creelful of BIG bass from a "fished out" lake in half an hour . . . and see the amazement on the faces of men who'd been fishing the same water unsuccessfully for months?

Jason Lucas performs "miracles" like this regularly. And he sees no reason why *you* can't do the same. As America's most popular fresh-water fishing editor, he puts in 8 to 12 hours fishing daily . . . in order to discover what makes fish bite. In every kind of water. At every hour of the day. In every season of the year.

Isn't that the kind of know-how you need . . . so you can crowd more fun into the precious few hours you have for fishing?

Knowledge of Bass Pays Off

Well, here it is. All the inside tips. All the know-how tricks. All the amazingly simple techniques you need to get more fish every day of your fishing life. Yours on amazing six month trial basis.

How would you like to know the methods which produce sensational catches in the very spots where other methods fail? How would you like to glance at the countryside . . . and get a feel for how the bass are biting in the nearest lake?

How would you like to perform one act, the minute you jump in the boat, which boosts your chances of catching bass? How would you like to "sort out" any river or lake into "good," "fair" and "bass" sections . . . so you know where to invest your time?

Fishing Science Made Simple

How would you like to have Jason Lucas by your side, in your boat . . . telling you the tricks which get MORE STRIKES? How'd you like to hear about the retrieve he discovered by accident, which is particularly deadly on big lunkers?

It's all here. The most productive tips for largemouth and smallmouth bass accumulated in a lifetime of scientific fishing. There are methods that work in Spring . . . Summer . . . Fall . . . even Winter. A way to locate *groups* of lunkers. A way to catch up with that big tackle buster "that got away."

Name Your Fish—and Catch It

Bass secrets are only part of the story. There are also exciting chapters packed with muskie tips . . . tricks with pike . . . know-how on walleyes . . . fly fishing for sunnies . . . spinning for crappies. Learn how Lucas took king-size walleyes from a lake which hadn't yielded a single walleye in 10 years. Learn how he took the limit, every evening for 6 weeks, from another "fished out" lake just a few minutes drive from a big city full of fishermen.

How-To Drawings and Photos

Page after page of full-page glossy photographs shows you exactly how Lucas goes after fish so successfully. Dozens of specially drawn diagrams show you how to wind a rod, make a reel arbor, tie fishermen's knots like an expert. And much more.

Unsurpassed Equipment Know-How

Lucas gives you the straight facts as he sees them about rods, reels, lines, hooks and lures. He warns you clear of expensive items which are overrated . . . and tells you how to take bass, muskie, pike, walleye, panfish . . . on the tackle which best suits your taste and budget.

You learn how to test hooks for sharpness. How to pick the best hooks, lines and leaders. There's advice on lures which are deadly in *some* waters at *some* times . . . and useless in other waters at other times. Learn the *right* place and time.

You learn simple thermo-dynamic tricks to help you locate fish . . . and what U.S. Army research with "black light" can tell you about fishes' color perception, and the types of lure you should use.

Accept Book on Six Months Trial Basis You Must Catch Fish or Pay Nothing

Frankly, we are eager for our readers to try LUCAS ON BASS FISHING. We want to send it to you on a six month trial basis . . . with a GUARANTEE that its know-how will work for you. But the edition is selling out fast. You must claim your copy *now*.

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Rush me LUCAS ON BASS on amazing six month trial offer. After 10 days I'll remit only $1 a month until bargain price of $5.98 plus shipping is paid. If Jason Lucas does not cause me to catch more bass, bigger bass, and have more fishing fun, I can return LUCAS ON BASS for full refund even after 6 months!

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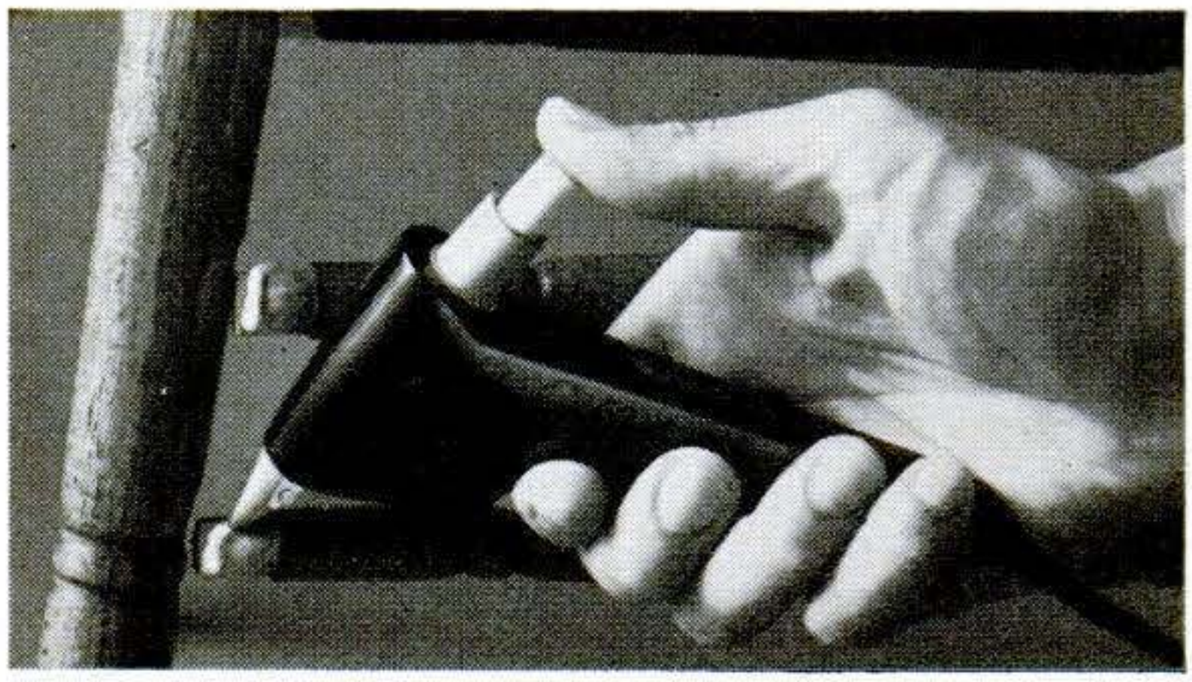
It's amazing how many fix-it problems you can solve in 60 seconds with a THERMOGRIP® electric glue gun



How many fix-it jobs are you putting off until you can find the time to do them right? Now you don't need time. The Thermogrip Electric Glue Gun bonds almost anything *in just 60 seconds!* No clamps. No waiting. Uses solid sticks of Thermogrip industrial-type hot-melt glue. Also applies instant-set water-proof caulking. At hardware stores. $7.95 list

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Free Thermogrip Glue Gun booklet gives how-to-do-it information on all jobs listed here and many more. At your hardware store. Or write Dept. PS at USM, address shown below.

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Science Newsfront

[*Continued*]

structural material and glass-wall exteriors. The problem, which is being explored by Prof. John Goldberg of Purdue University, is that high-strength steel columns, which can support a greater compressive load than old-style thick columns, are susceptible to buckling because of their slenderness. Secondly, walls made of glass cannot be counted upon to stiffen a building. Prof. Goldberg's answer is a new computer program that considers every floor of a building and determines within 20 minutes if its design is safe.

Airplane checks your TV viewing

If you hear an airplane circling overhead the next time you turn on your TV set, it may be listening to signals emitted by your receiver to find out what channel you're watching. The system, recently patented by Arthur E. Jenks and David W. Ginn of Television Audit Corp., Winter Park, Fla., is based on the fact that when a TV set processes an incoming signal, it generates a small signal of its own. From the air, it is possible to analyze these signals and make an accurate measurement of the popularity of any one channel. The monitor plane can cover over a million TV sets in a 30-minute period.

Small cars have more one-car accidents

The long-standing debate about the safety of small cars shows signs of heating up. J. Stannard Baker of Northwestern University, who analyzed 850 accidents involving only one car, draws these conclusions: Drivers in small foreign and sports cars have an accident rate 3½ times greater than drivers in standard cars. The risk rate for drivers in U. S. "compact" cars is 2¼ times as great, and adding a trailer to any kind of auto increases the accident risk four times.

Skiing—how not to do it

Ski injuries are unlike any others, and are a specialized field in themselves, reports *Medical World News*. One out of every six skiers injured during the past season suffered simple bruises, while three had soft-tissue injuries. Two out of six had fractures ranging from chipped ankles to spiral or twist fractures of the leg bones. Impact injuries such as shoulder dislocations are more common during cold weather with little snow, while warm weather and deep snow bring torsional or twist fractures from turning. Most injuries occurred during the first two hours of skiing before the skier was warmed up. But conditioning exercises may do more harm than good: Deep knee bends actually add to knee instability by stretching ligaments.

Thunder and lightning aid radio studies

The Amazon Basin in South America, notable for heavy thunderstorms and lightning, is helping scientists understand how very-low-frequen-

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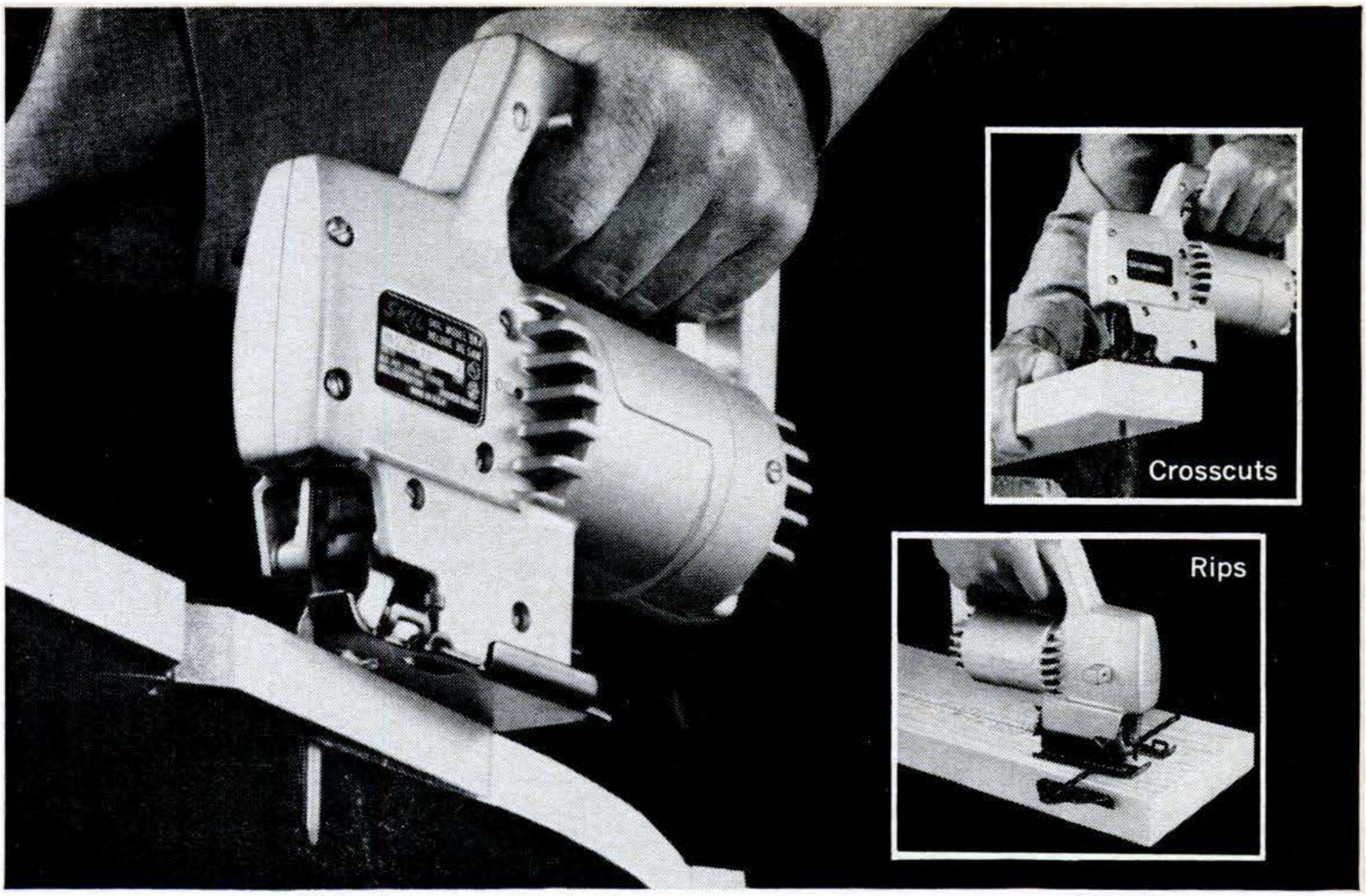
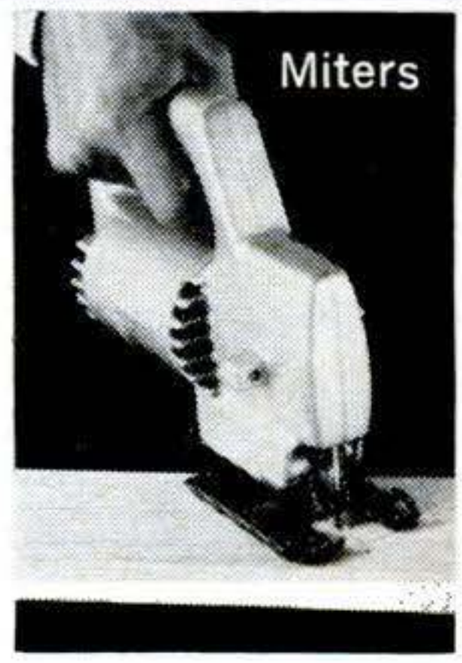
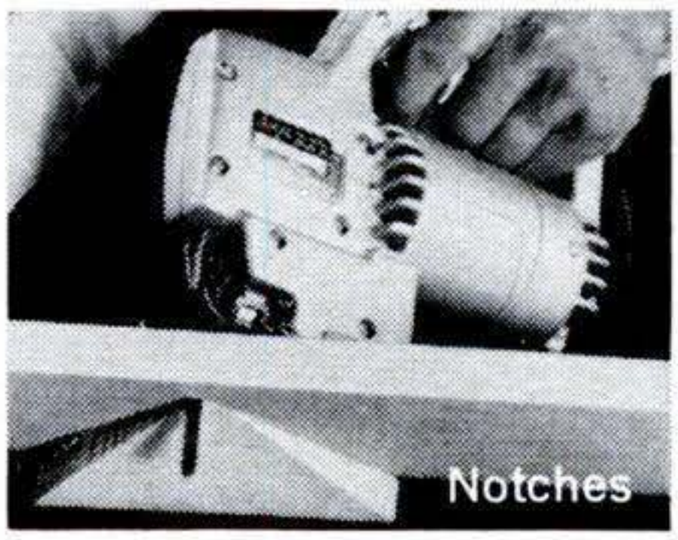
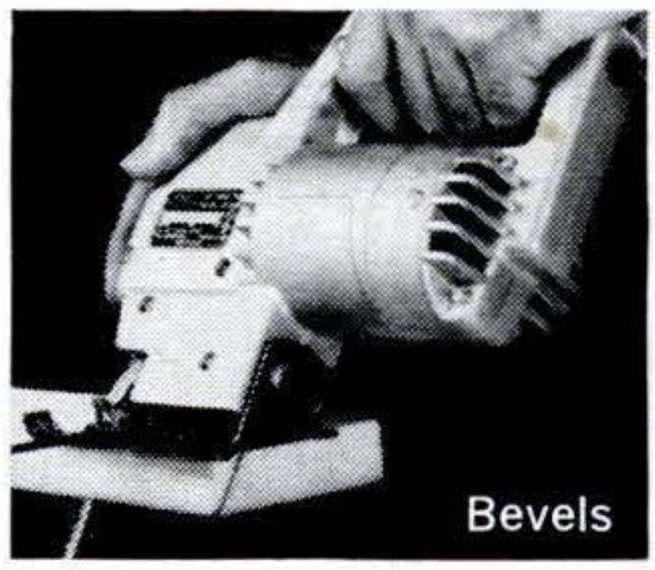


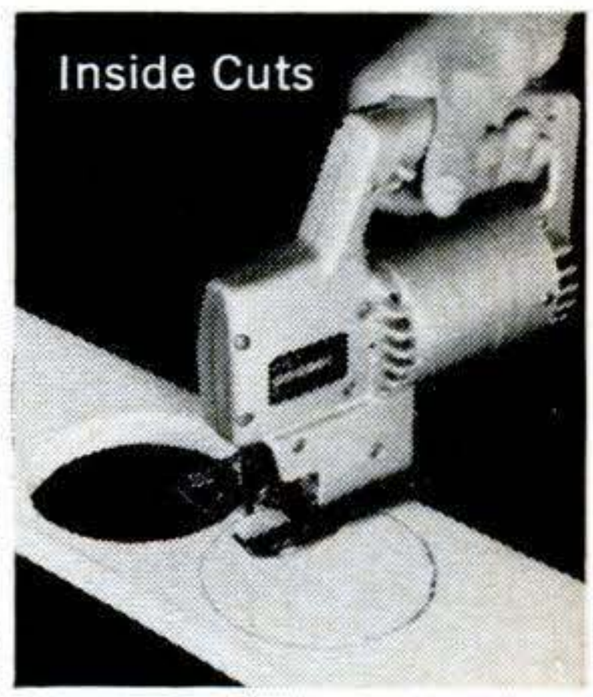
Make fancy scroll cuts like a pro

Skil Jig Saw does the work of 7 saws—plain and fancy

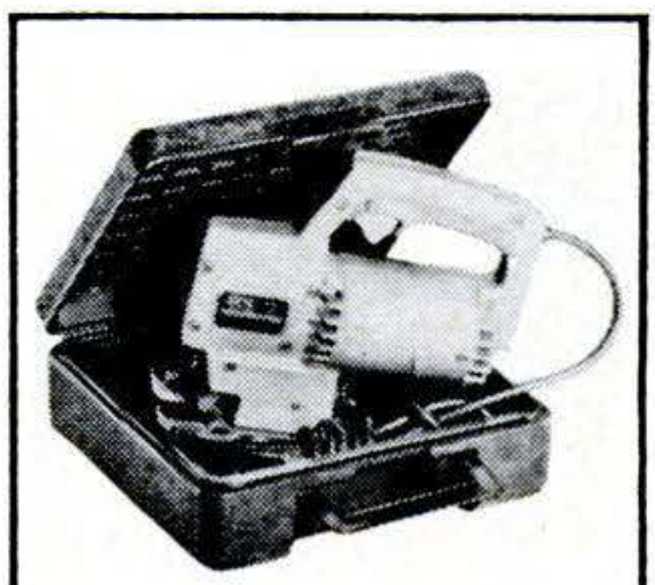








Why struggle with hand saws, when for less than $32 you can own the work-savingest power saw made—the Skil Jig Saw. Does the work of 7 different saws—rip saw, crosscut saw, sabre saw, hack saw, keyhole saw, scroll and coping saw, and band saw. Cuts any material. Wood, metal, plastic, compositions, plaster board. At better lumber dealers, hardware and department stores. Skil Corp., Chicago, Ill. 60630.



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cy radio waves travel through the atmosphere. During each lightning discharge, radio energy is released at frequencies slightly above the audio range, and can literally be heard around the world. In the University of Miami study currently under way, the discharges are recorded at the site by a semitrailer loaded with electronic equipment. The data is then sent to the Environmental Science Services Administration office in Boulder, Colo., to compare with lightning signals received there.

Questions we never asked

What does a fish live on in winter? Whether or not this problem has caused you a great deal of concern, scientists at Kansas State University have an answer. Channel catfish kept outside in winter weather without food for eight months were found to live off body fat and when that was gone, body protein. The fish actually do better outdoors than in. Reason: Lower temperatures lower body metabolism so that they need less energy. A rapid weight gain then takes place in the spring.

Hologram "photos" made with ordinary light

True 3-D pictures—holograms—can now be made outdoors or by means of ordinary illumination, with a conventional camera having a special lens. Until recently, a laser was required to make holograms, and pictures were limited to small objects. A new two-step process under development by IBM uses a camera with a multifaceted "fly's eye" lens. The fly's-eye image recorded on film consists of hundreds of tiny individual pictures showing the scene from different angles. The film is developed in the laboratory and laser light beamed through it and back through the lens. The interference between this beam and a reference beam creates a hologram on a second piece of film, which can be used to recreate the original scene in three dimensions.

Is the universe round?

Just as Columbus showed that the earth is round, two Princeton physicists are attempting to prove that the universe is spherical. The scientists are using a microwave radio telescope—tiny in comparison with conventional radio telescopes—designed to detect radio emissions resulting from the "big bang" explosion that formed the universe [see "They're Solving the World's Greatest Mystery," PS, Nov. '65]. Drs. David T. Wilkinson and R. Bruce Partridge have found that an almost equal amount of radiation reaches the earth from all directions. The conclusion? The universe is spherical to better than one part in 300—about as round as the average tennis ball. PS

Special offer to pipe smokers who smoke these brands

First of all, congratulations on your good taste. They're fine tobaccos every one.

But I'll bet that, like most pipe smokers, every so often you get the urge to try something different.

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It's an offer you ought to consider if you're a serious pipe smoker. Here's why.

1. Kentucky Club Mixture is probably the mildest aromatic pipe tobacco around. Most smokers can enjoy pipeful after pipeful without "bite".

2. It's a clean, easy-to-light tobacco that's cut to stay lit right down to the bottom of the bowl.

3. The aroma is pleasing to most everyone. Especially women.

4. Most important, the flavor is smooth and rewarding. The result of the careful blending of 5 important tobaccos: White Burley, Virginia Brights, Weeds Cavendish, Turkish and Perique, plus a dash of Deer Tongue for flavor. (Deer Tongue, by the way, is a variety of wild vanilla. It's used as seasoning The way you might add salt to stew.)

So that's it. Kentucky Club Mixture is a mild aromatic blend made by people who believe it's best and are ready to prove it by sending you a supply.

For your free pouch mail your empty to: Kentucky Club Mixture, Box 6666C, Wheeling, West Va. And when you've smoked it, write and let us know how you like it.

Kentucky Club Mixture

*Unfortunately we can't picture all tobaccos. But the offer's good on any brand (except Kentucky Club Mixture). Offer good in U.S.A. and Canada only.

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The Bolens Estate Keeper

Take a tip from Arnold Palmer. Test-ride the Bolens Estate Keeper. Find out why no other compact tractor can even come close.

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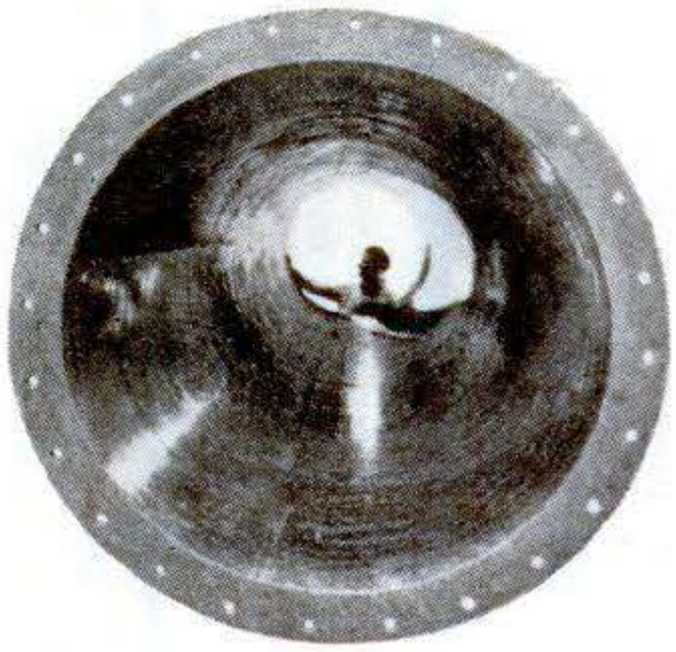
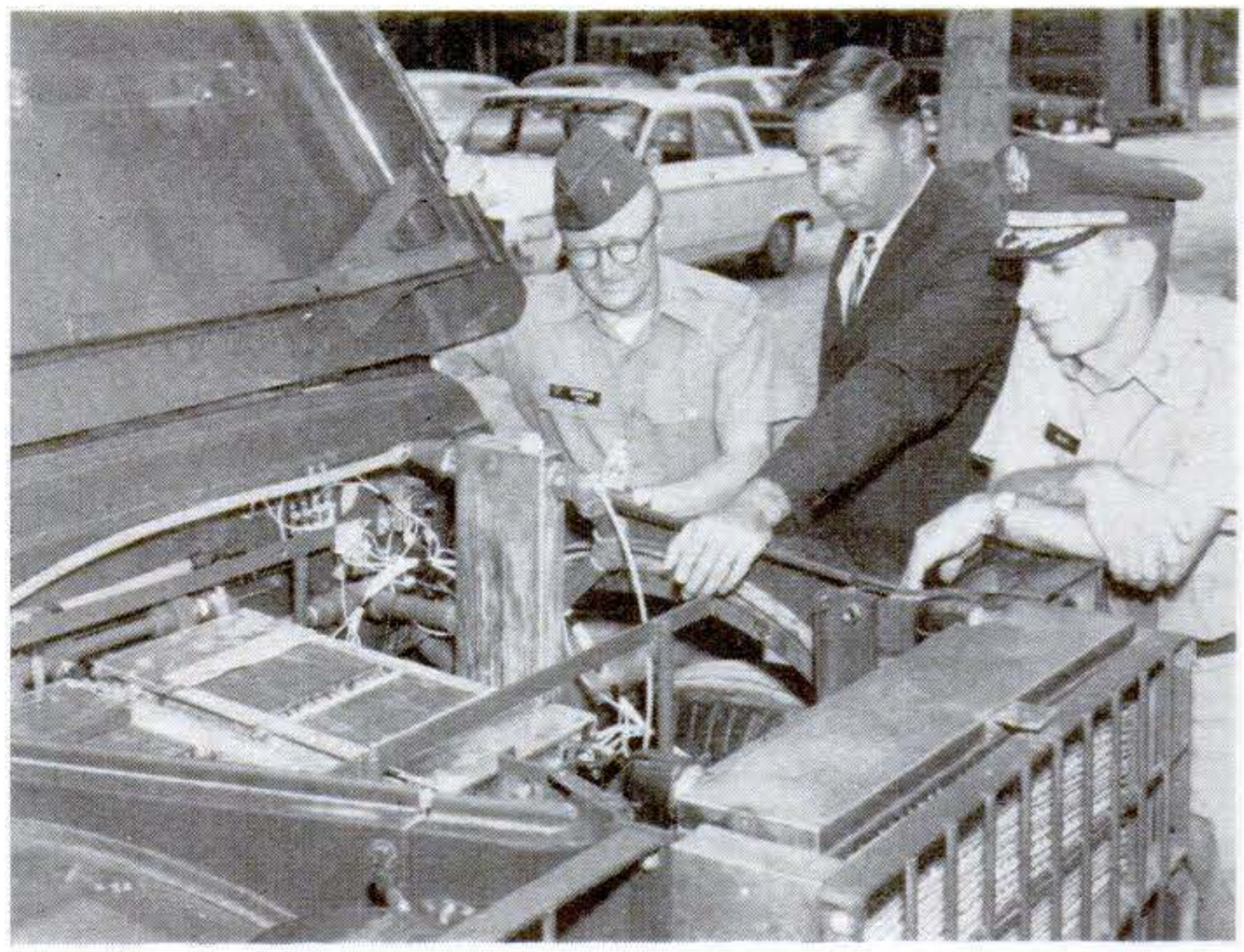
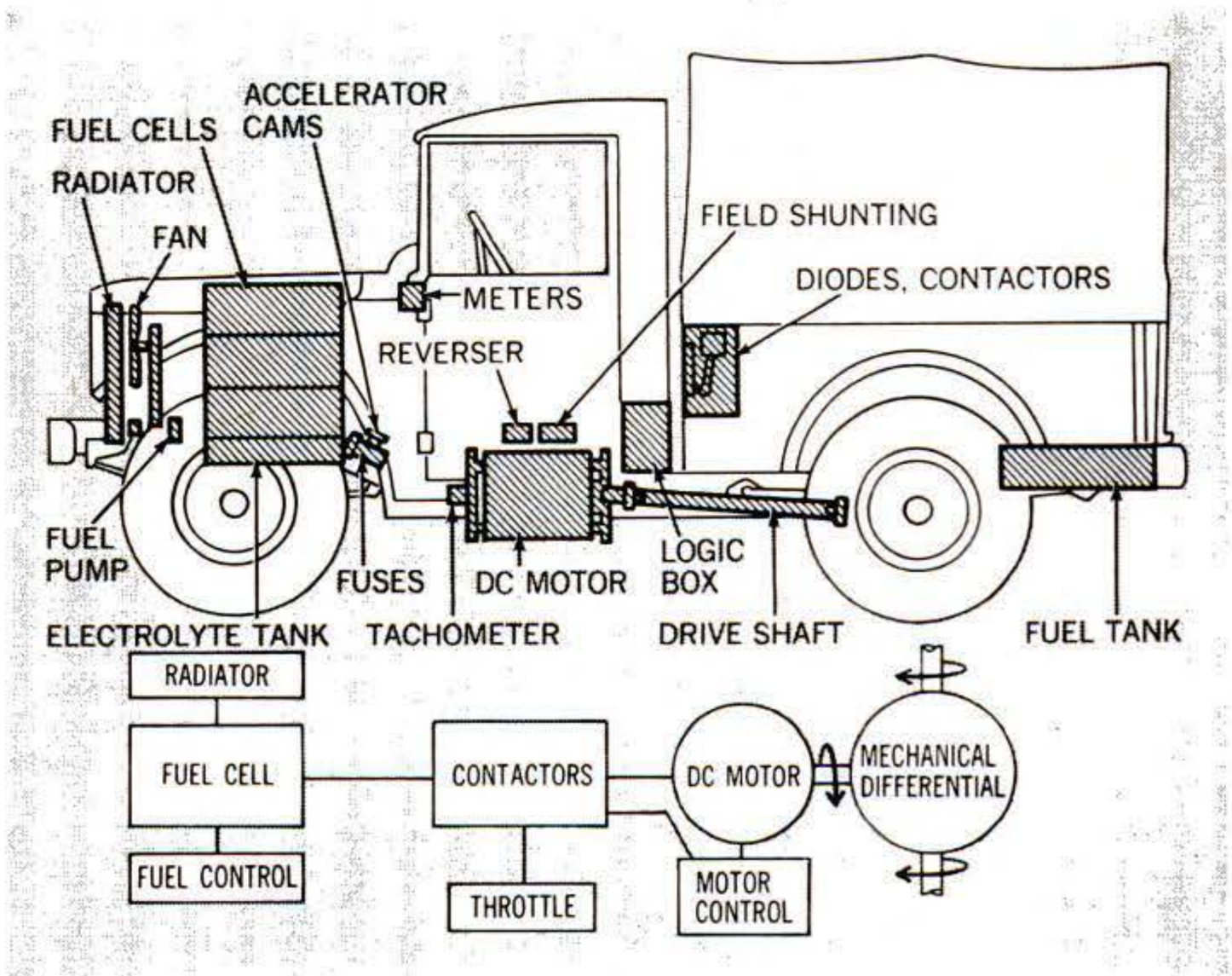
Lightweight chimney

This 120-foot chimney was bolted together out of eight separate fiberglass tubes. It is 500 times lighter than the brick one it replaced—at the Tooting Bee Hospital, London, England. The resin-bonded fiberglass tubes, three feet in diameter, are joined by flange bolts. The chimney was lifted into place by a crane. Its light weight made possible an economical foundation that would be inadequate for a brick or steel chimney.





Army Officers at Ft. Belvoir, Va., inspect fuel-cell-powered truck.



Army tests its first fuel-cell-powered truck

Army engineers are testing an electrically powered truck in an attempt to develop a quiet, economical vehicle for carrying men and weapons. The ¾-ton truck gets its electric power from a 40-kilowatt hydrazine-air fuel cell, which contains eight five-kw. stacks built by the Monsanto Research Corp. This supplies direct current to a standard industrial series-traction motor running at a top speed of 3,900 r.p.m. The current flows through a stepless controller, to make driving the truck as easy as with a standard automatic transmission. The hydrazine fuel is actually less volatile than regular gasoline. Army engineers believe that a hydrocarbon fuel, which may give 100 to 150 m.p.g., can eventually be used to power the fuel cells. Tests have shown that the 40-kw. fuel-cell vehicle will perform as well, or better, than the ¾-ton truck with 94-hp. internal-combustion engine. When idle, the truck can generate electricity for on-board weapons, too.

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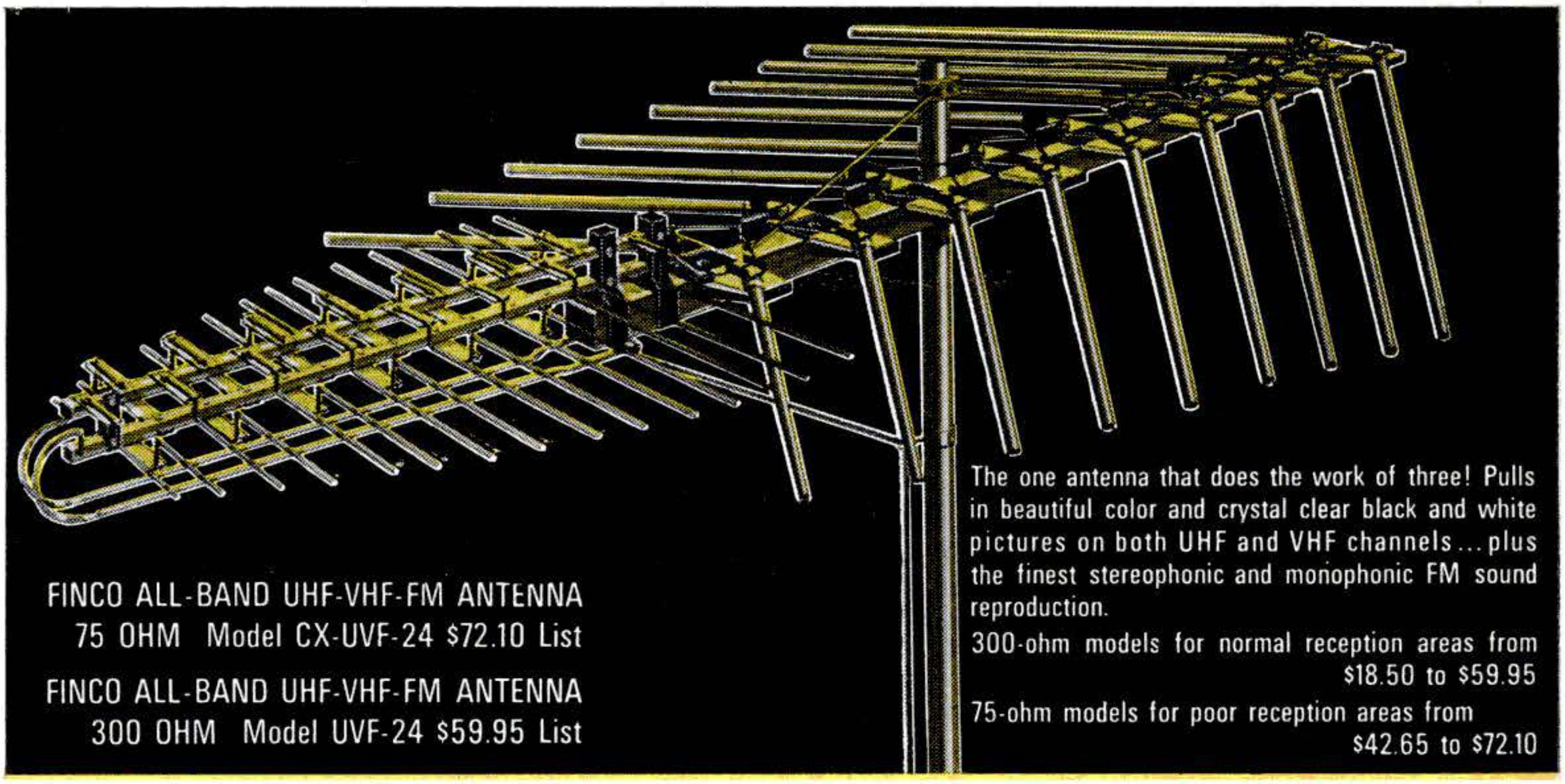

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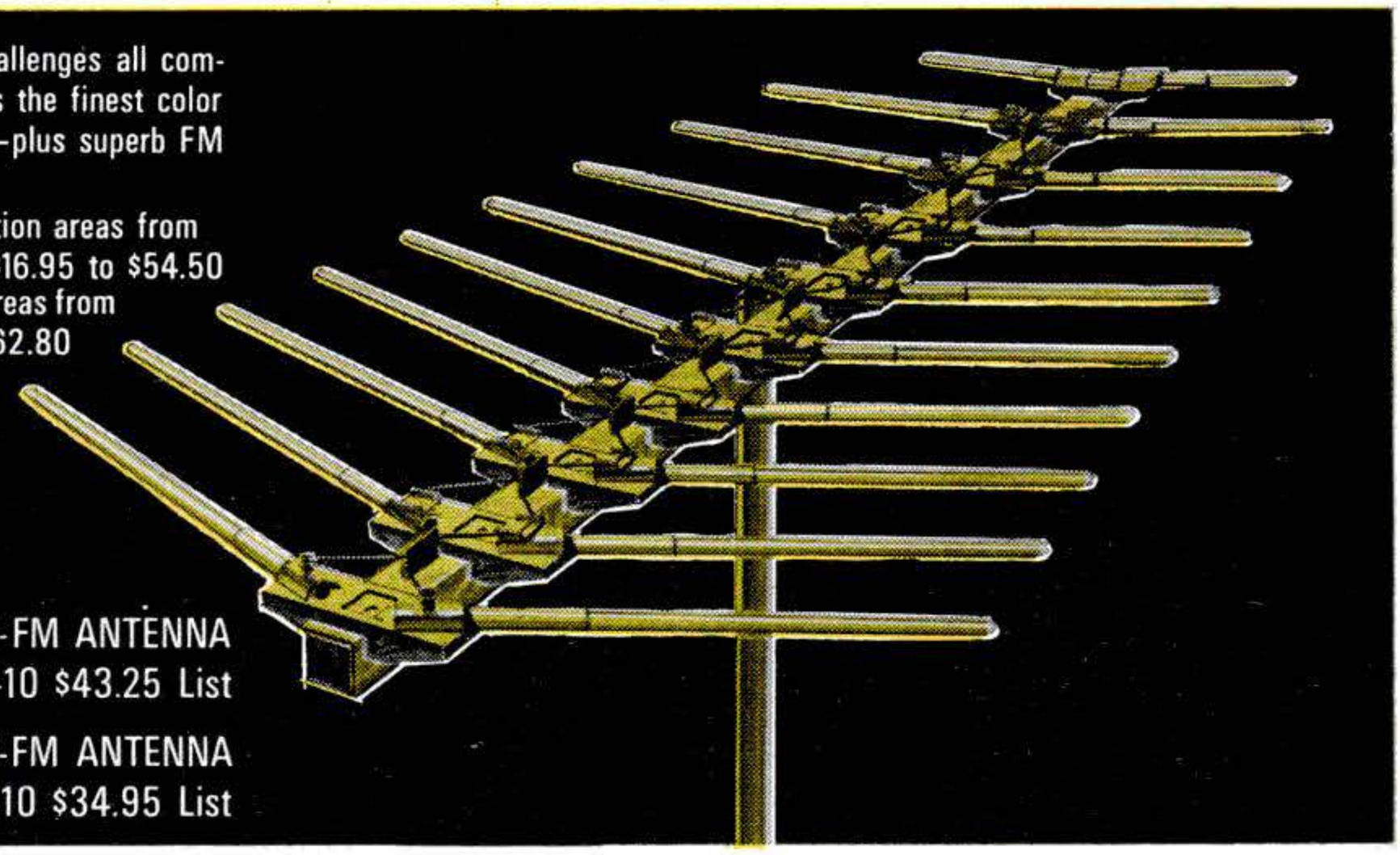

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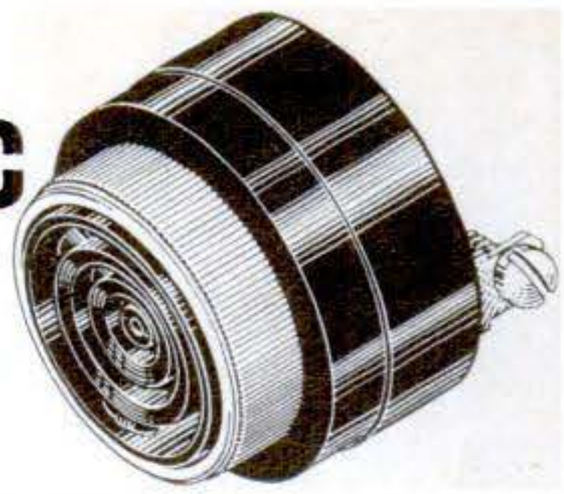

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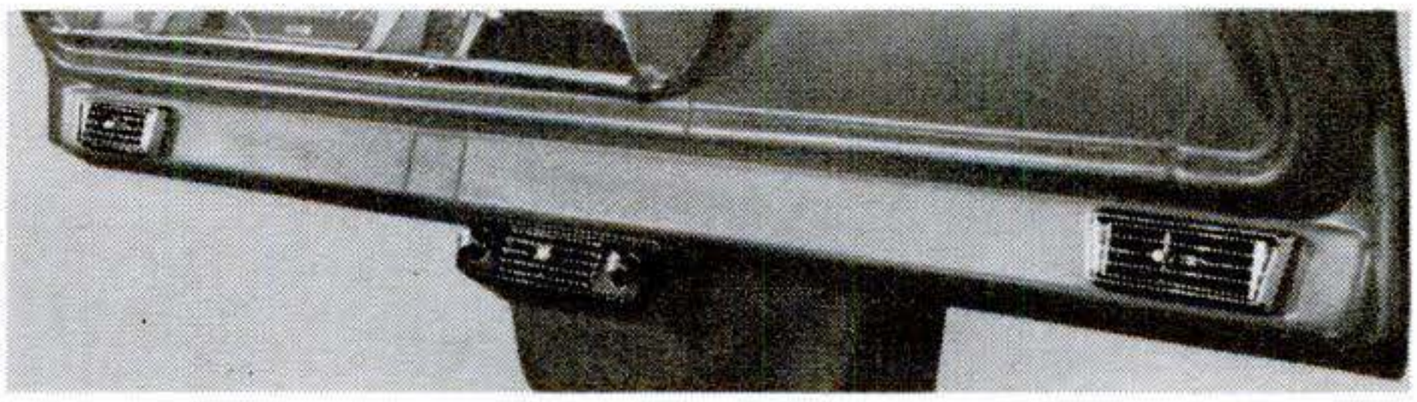

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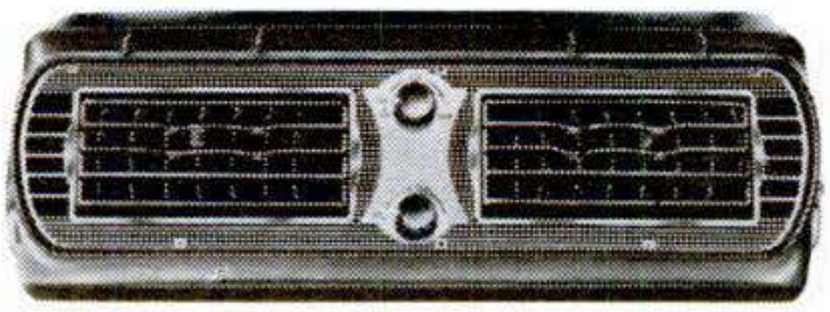

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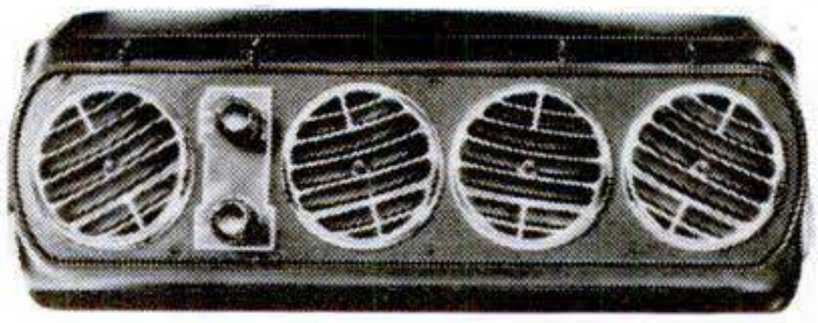

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YOU Can WIN Each Month!

Members of our Club win cash prizes at home, just by solving puzzles and entering Club contests. They turn an educational and enjoyable hobby into pure profit. **You can too!**

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IT COSTS YOU NOTHING TO TRY OUR CONTESTS AND SEE IF YOU HAVE THE TALENT TO WIN

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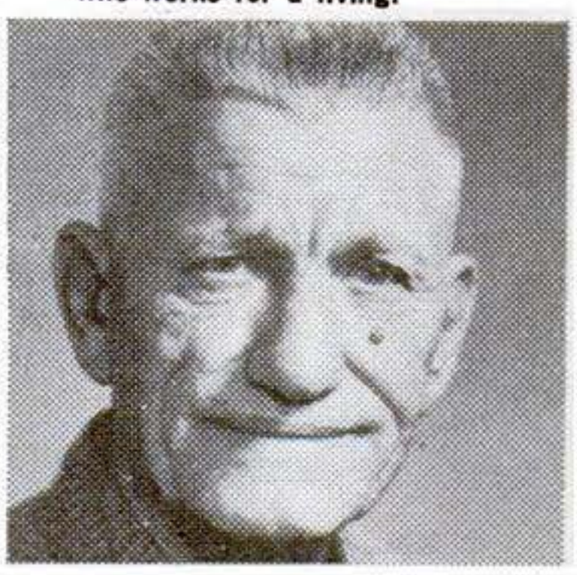
Send me a **free** copy of your newspaper plus all details on your cash prize contests. I am under absolutely no obligation to pay anything. If I join the Club I may compete for all prizes and spend the cash I win any way I want.

18-1

ENJOY YOURSELF IN YOUR OWN HOME AND WIN EXTRA CASH!

"I still can hardly believe it," Mrs. H. C. Despain of Houston, Tex., wrote to us after receiving $1,000.00 in cash as one month's winnings. She is a seamstress who works for a living.



Raymond Smith of Sacramento has won over $900.00 in Club competitions. A retiree, Mr. Smith's first win was only $25.00. Then, as he practiced solving our puzzles, he won much more.

"I was amazed to learn I won $500.00," said Mrs. Florence Humphrey of Cincinnati. "The prize money came at a dandy time as I've had some debts to pay off. Thank you."

WIN CASH MAIL NOW

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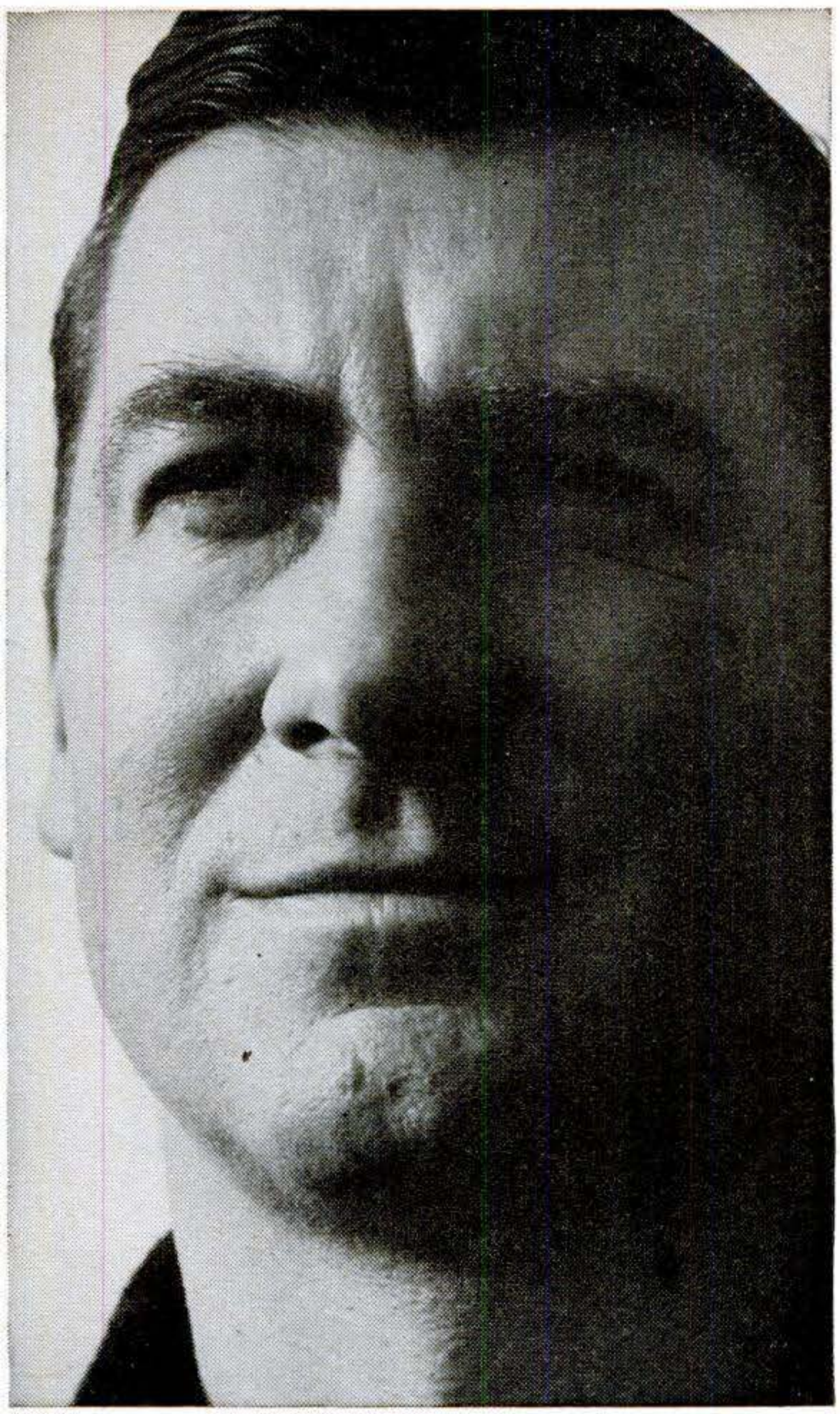

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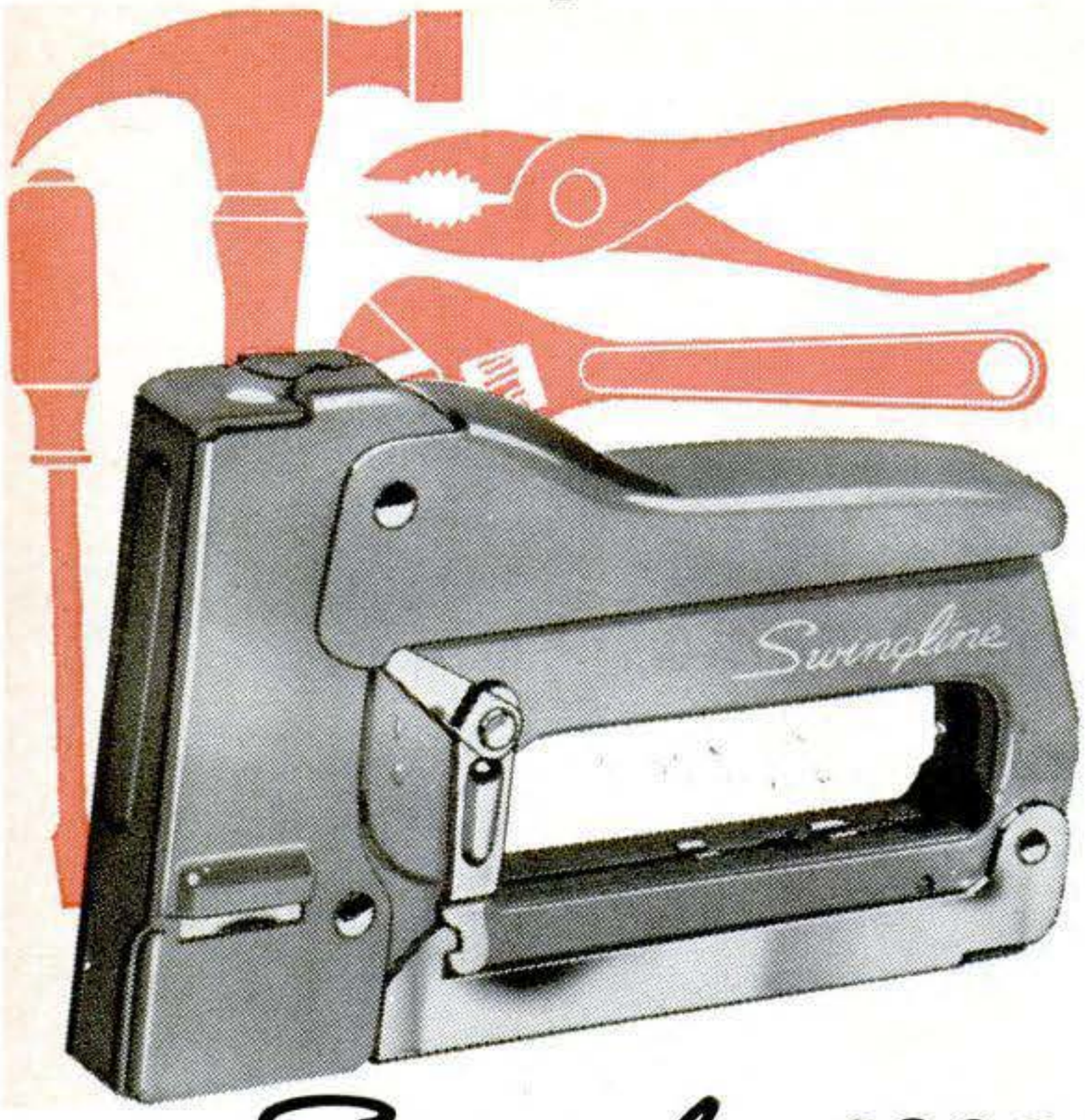

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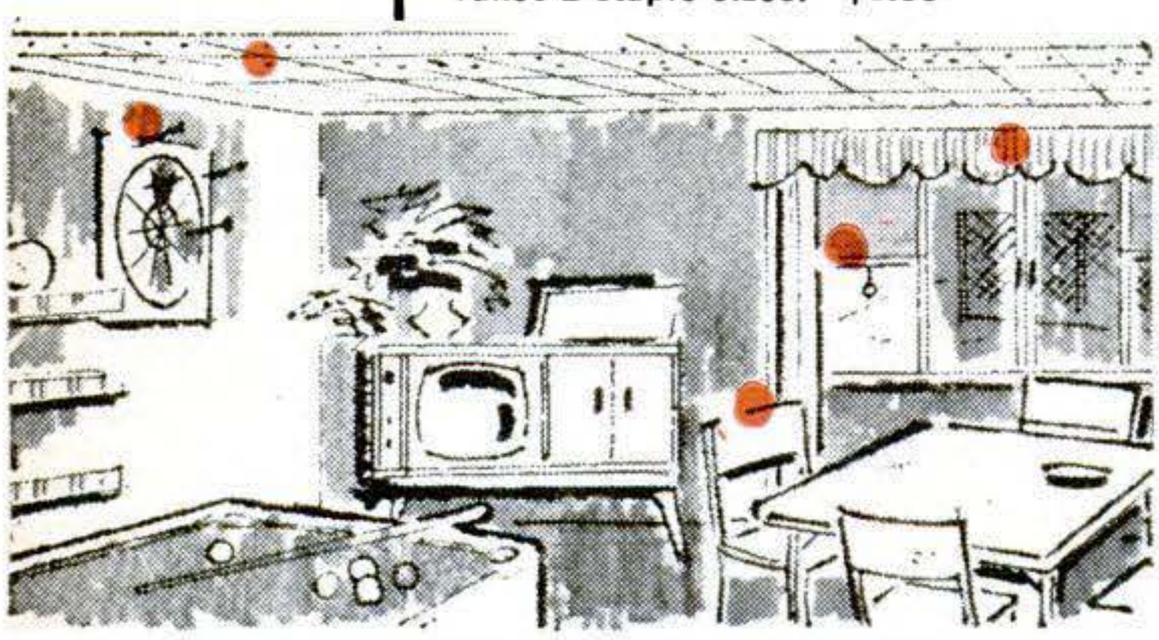

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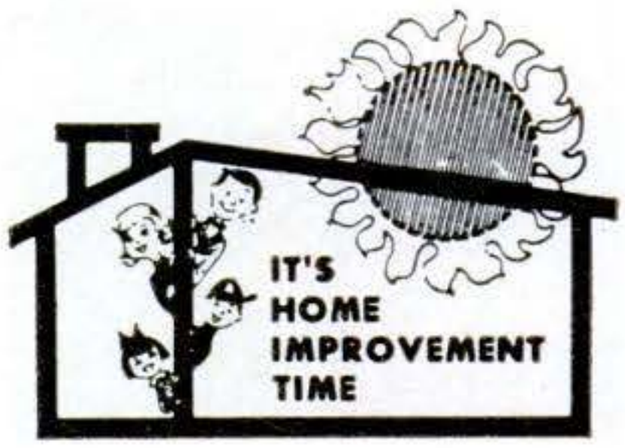

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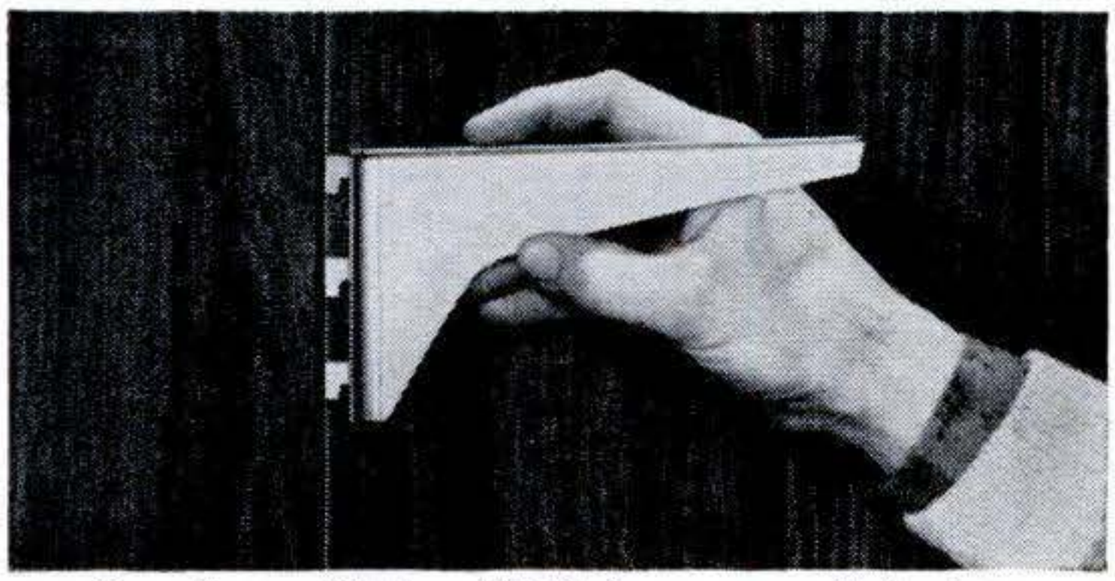

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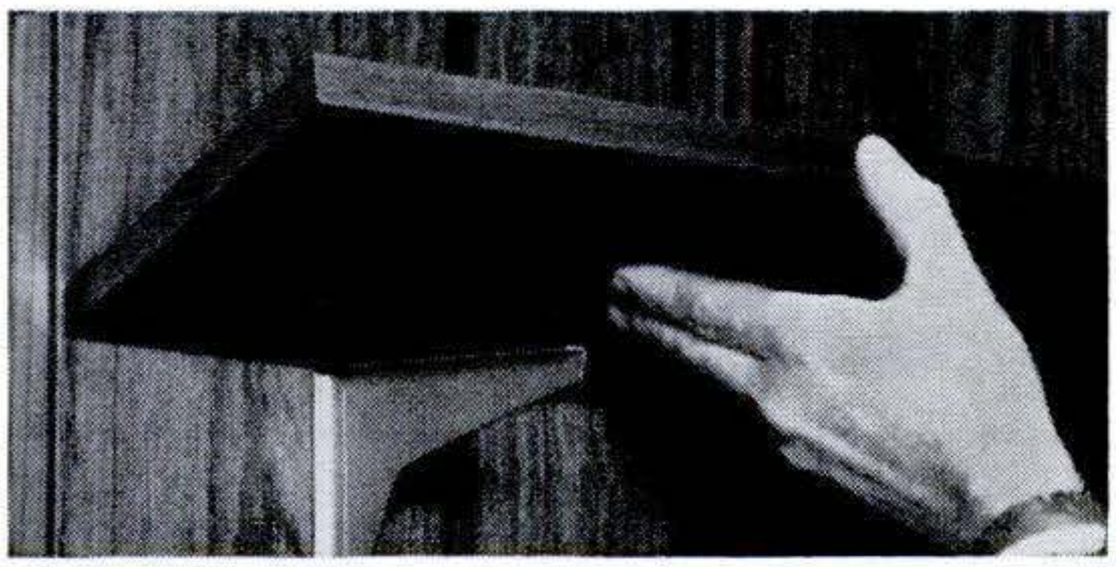

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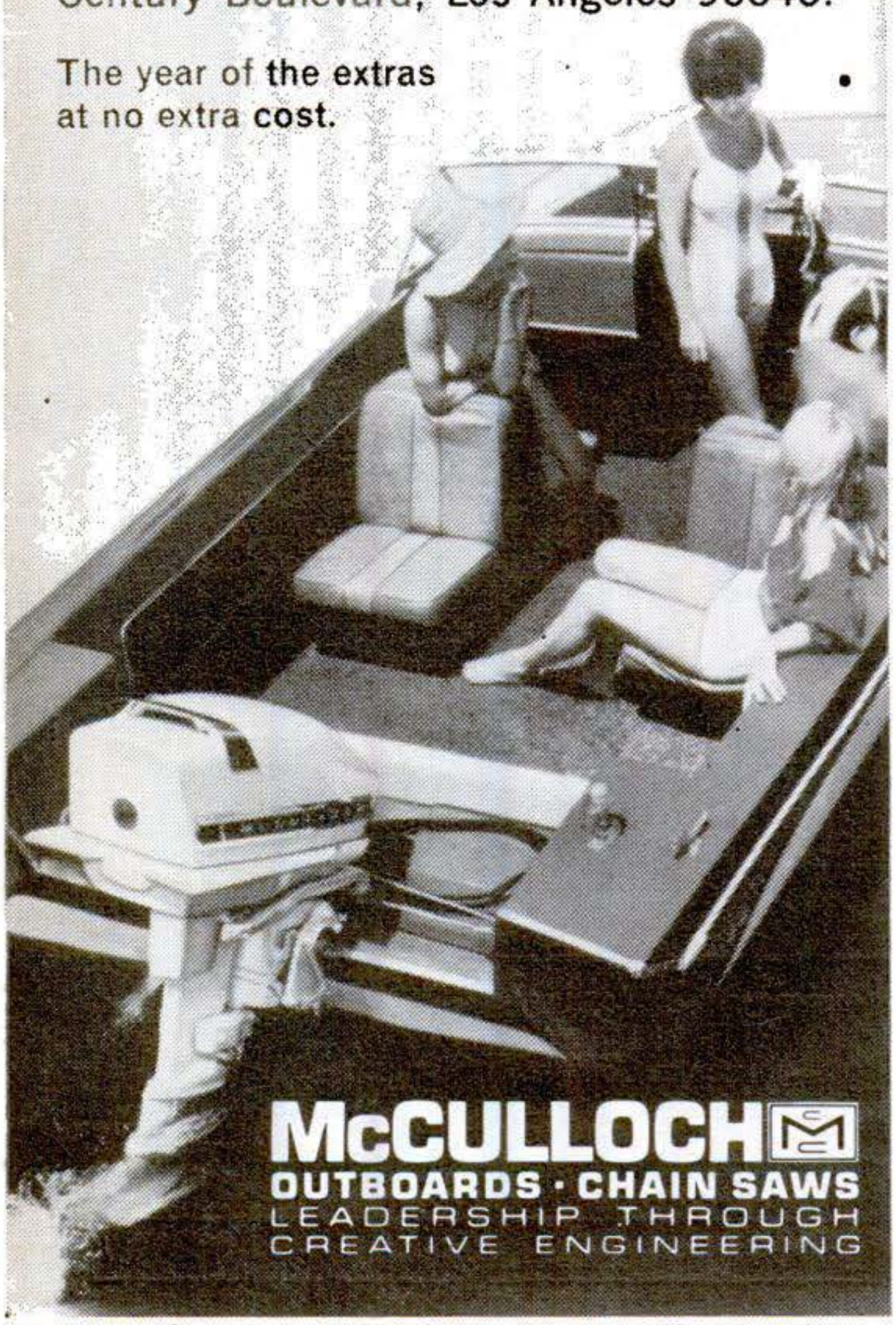

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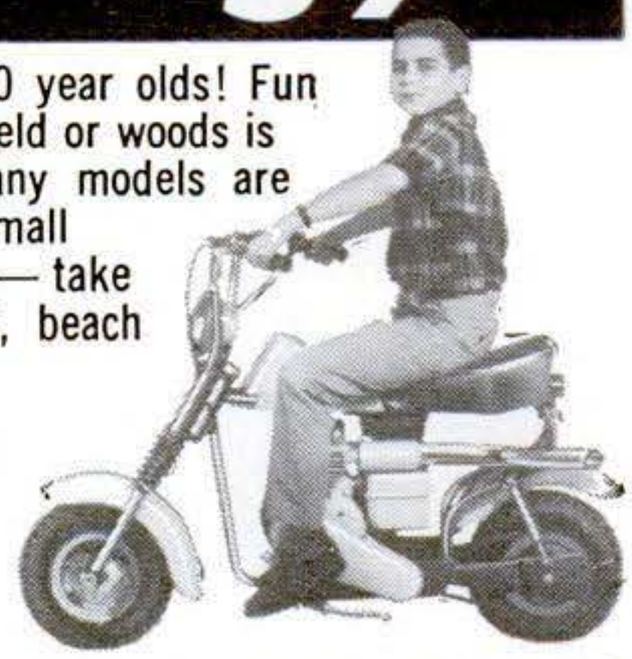

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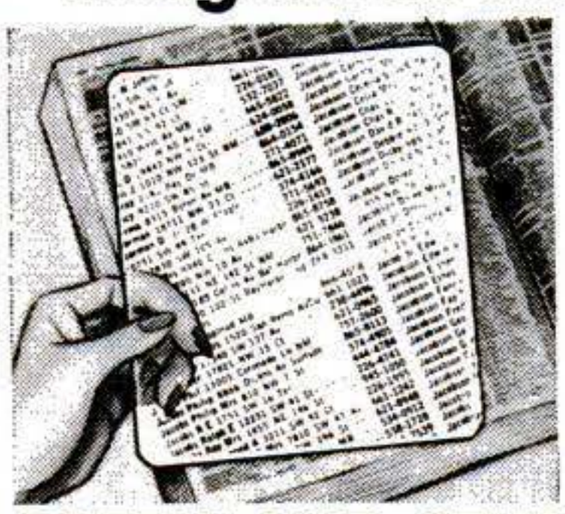

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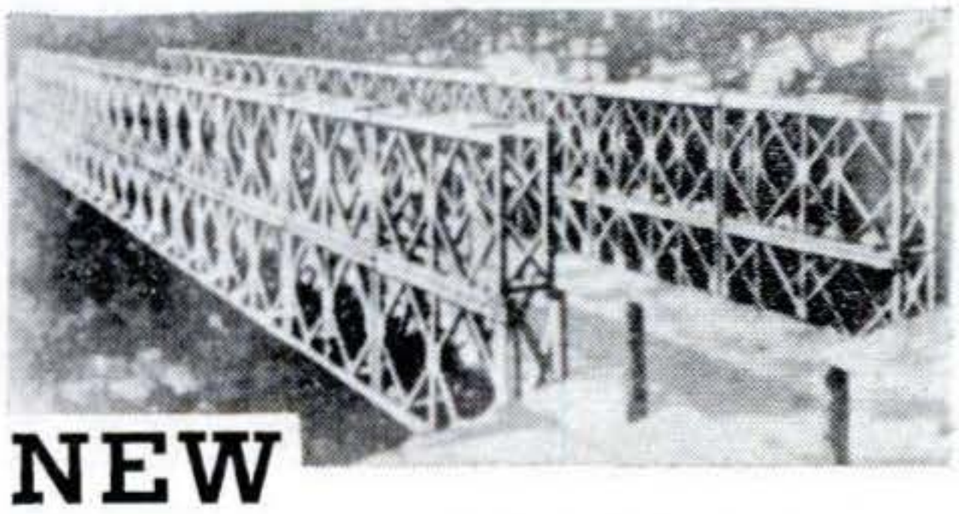

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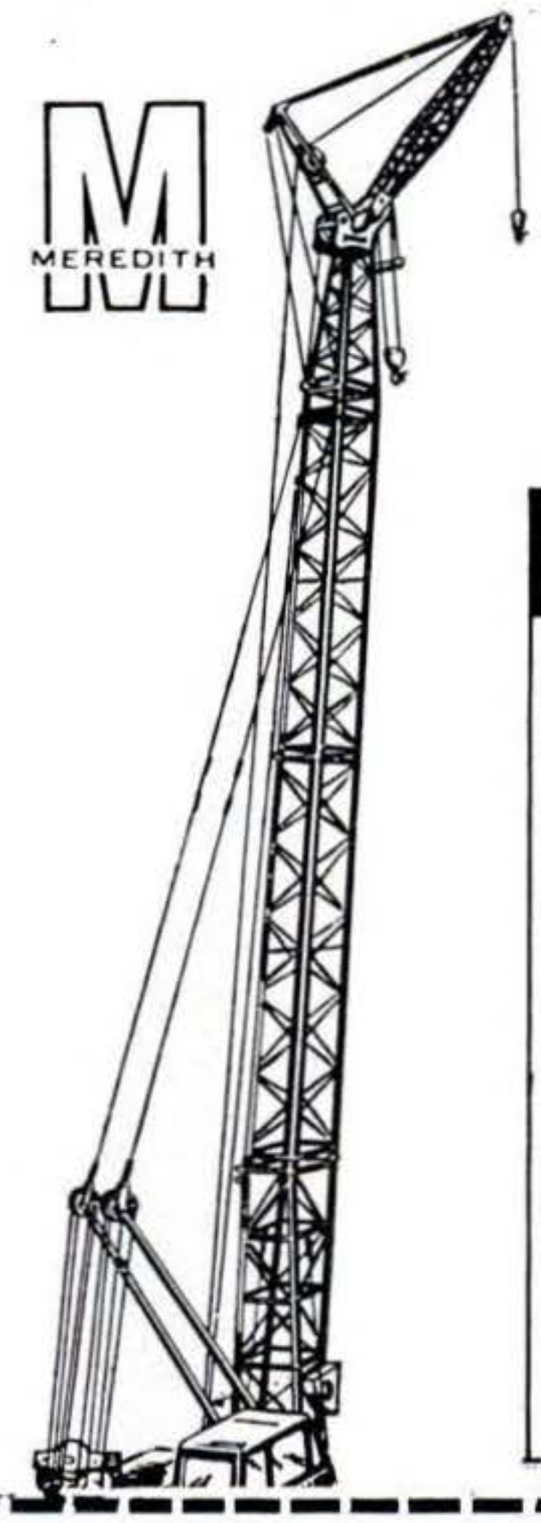

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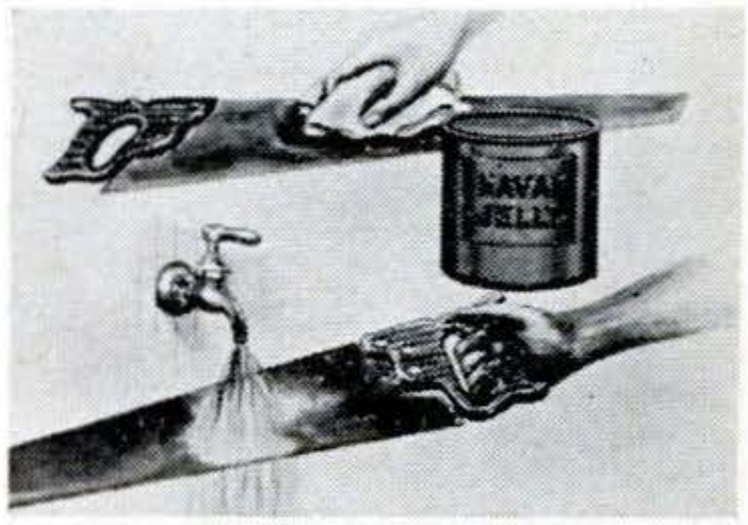

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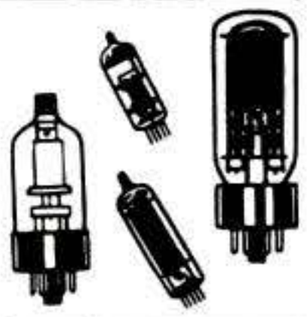

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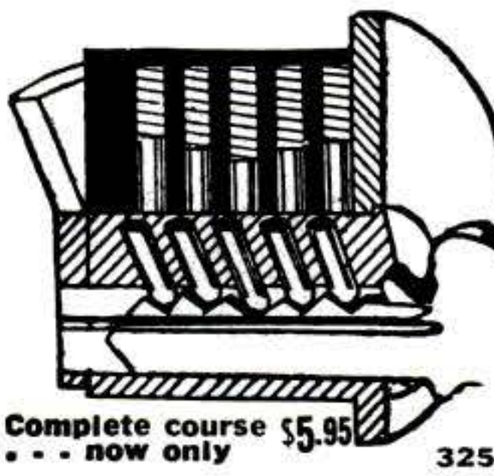

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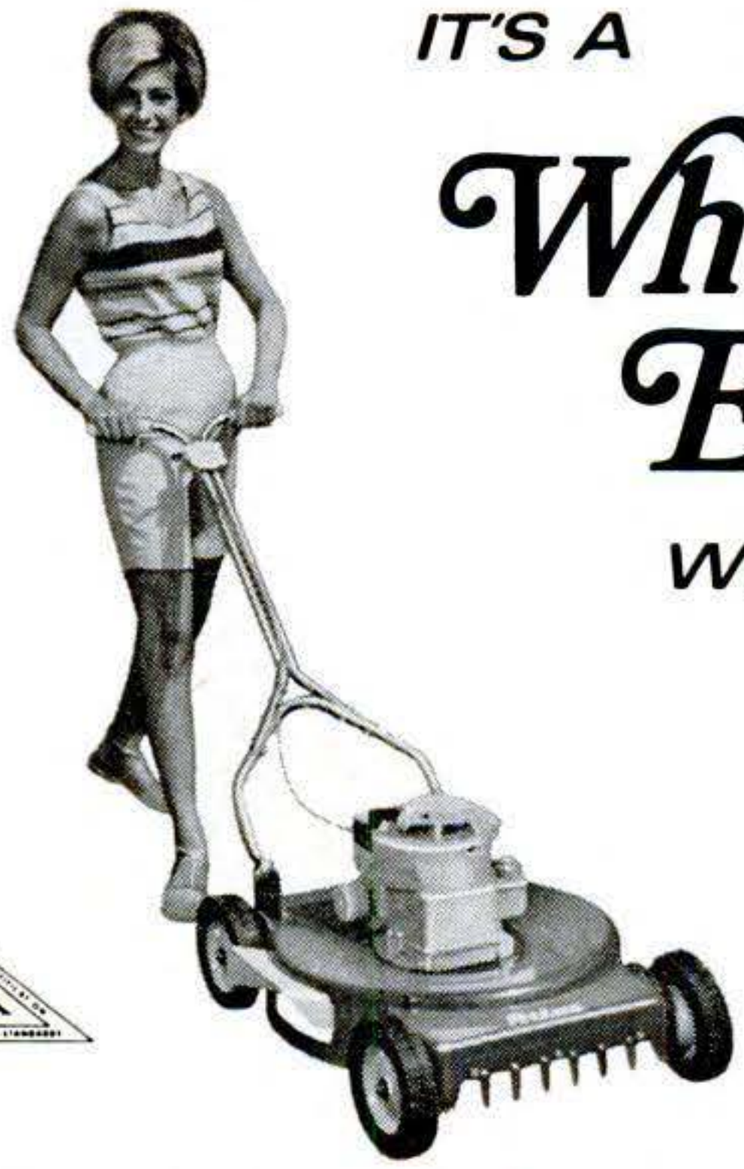

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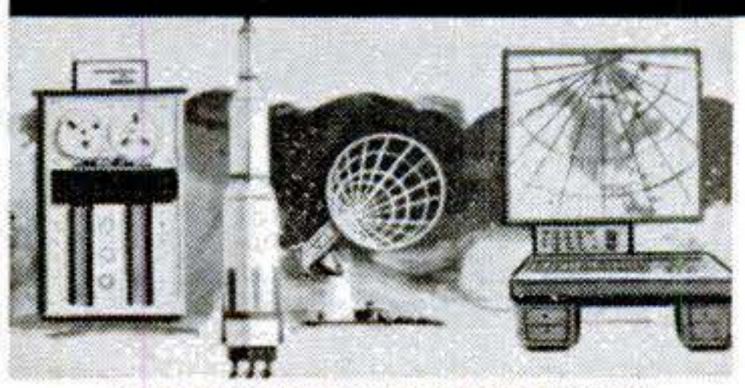

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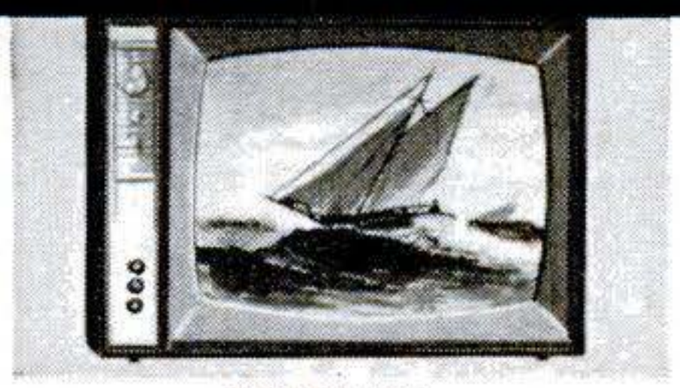

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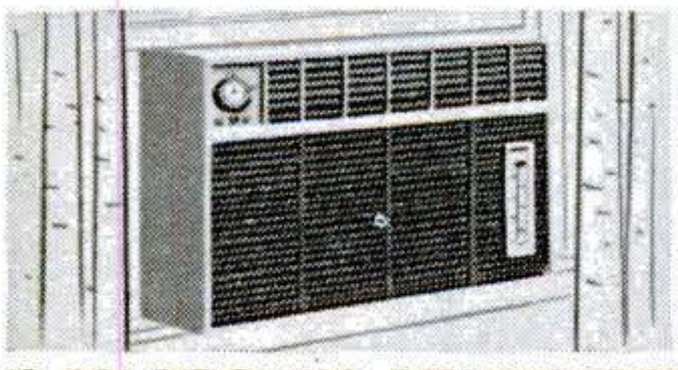

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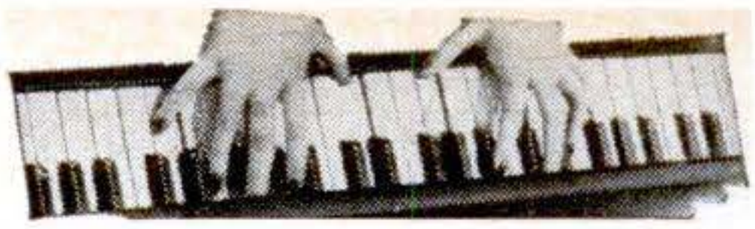

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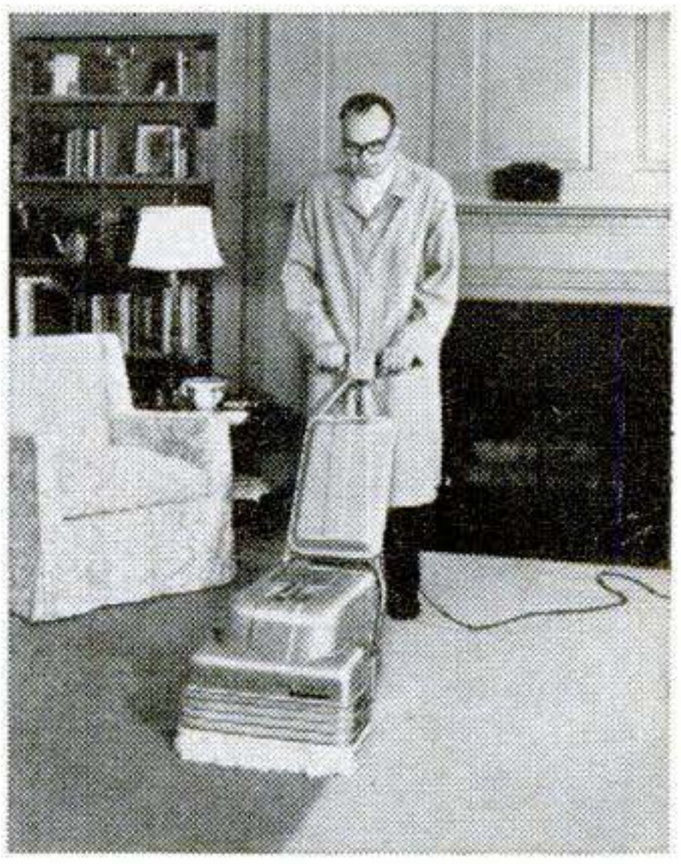

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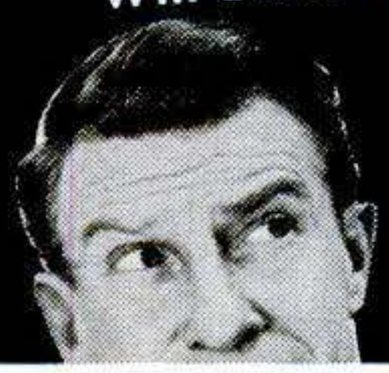

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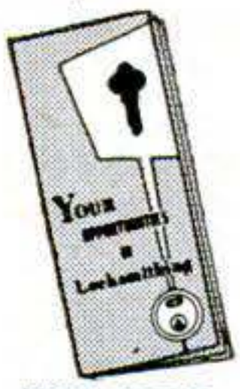

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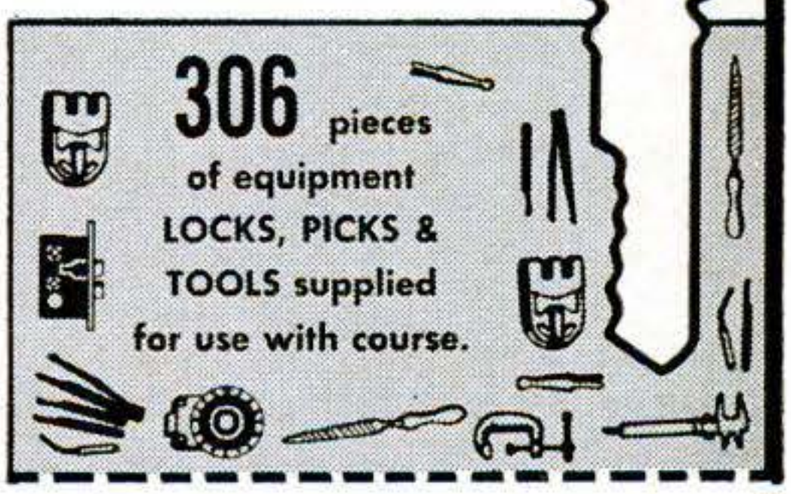

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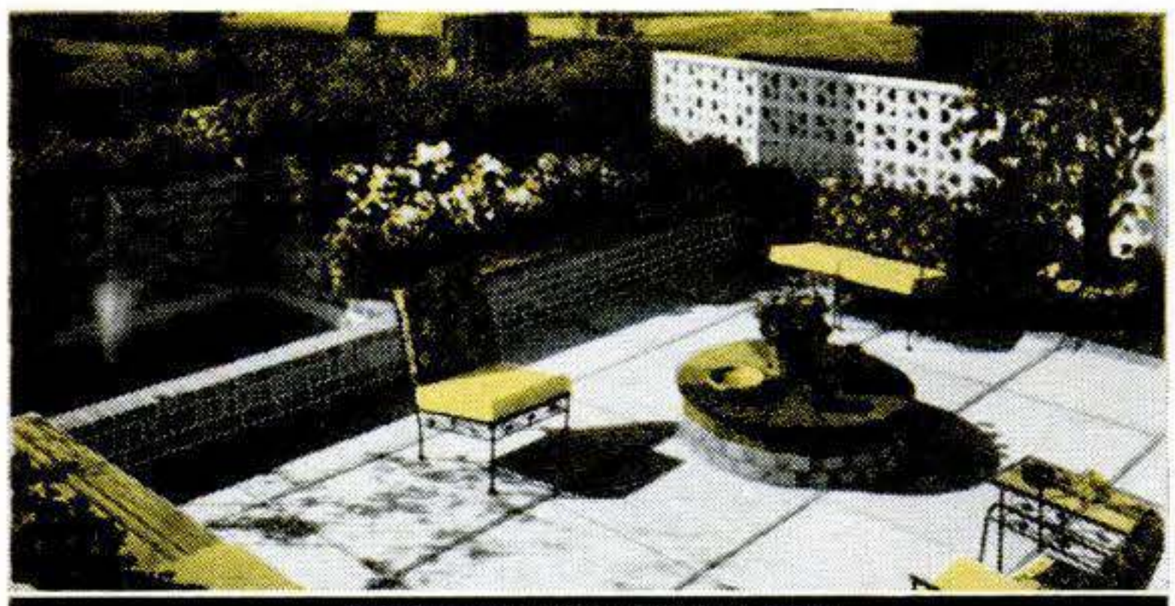

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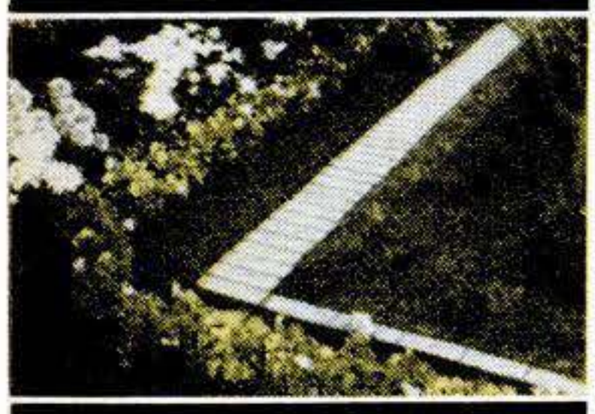

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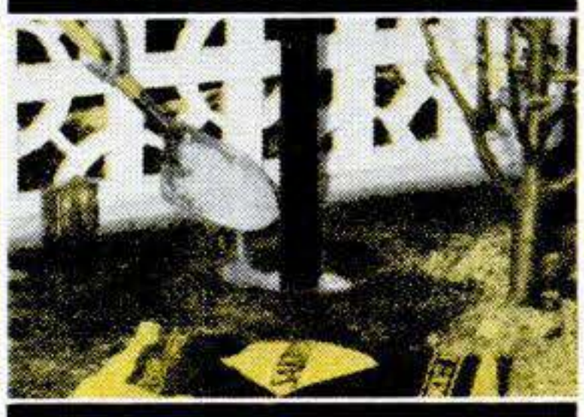

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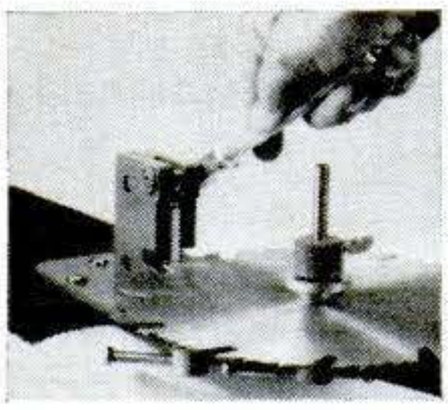

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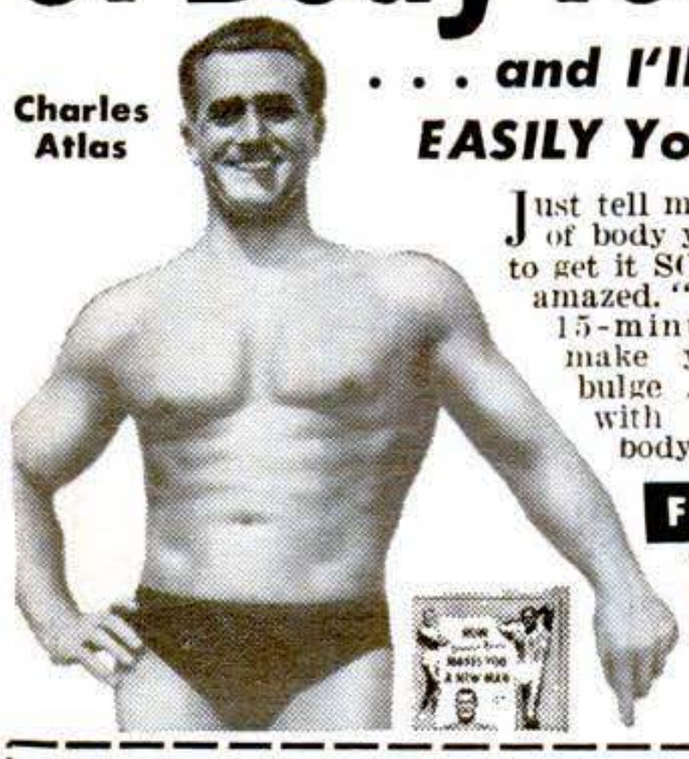

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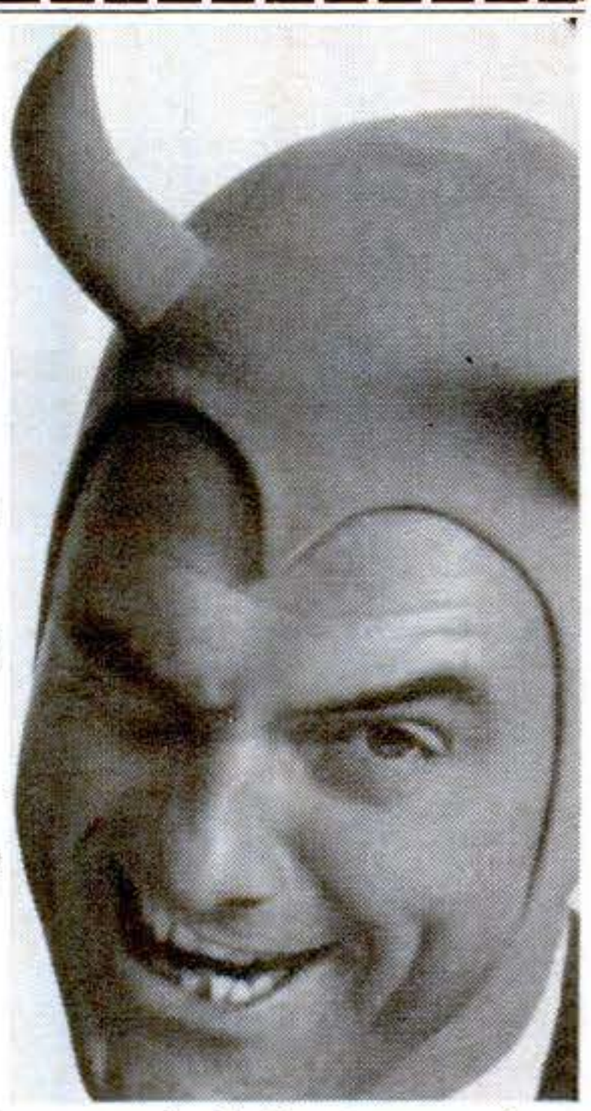

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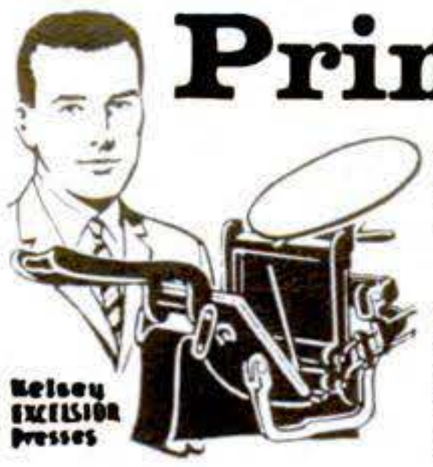

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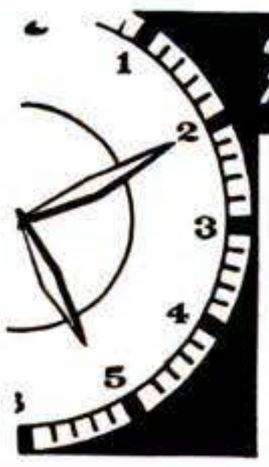

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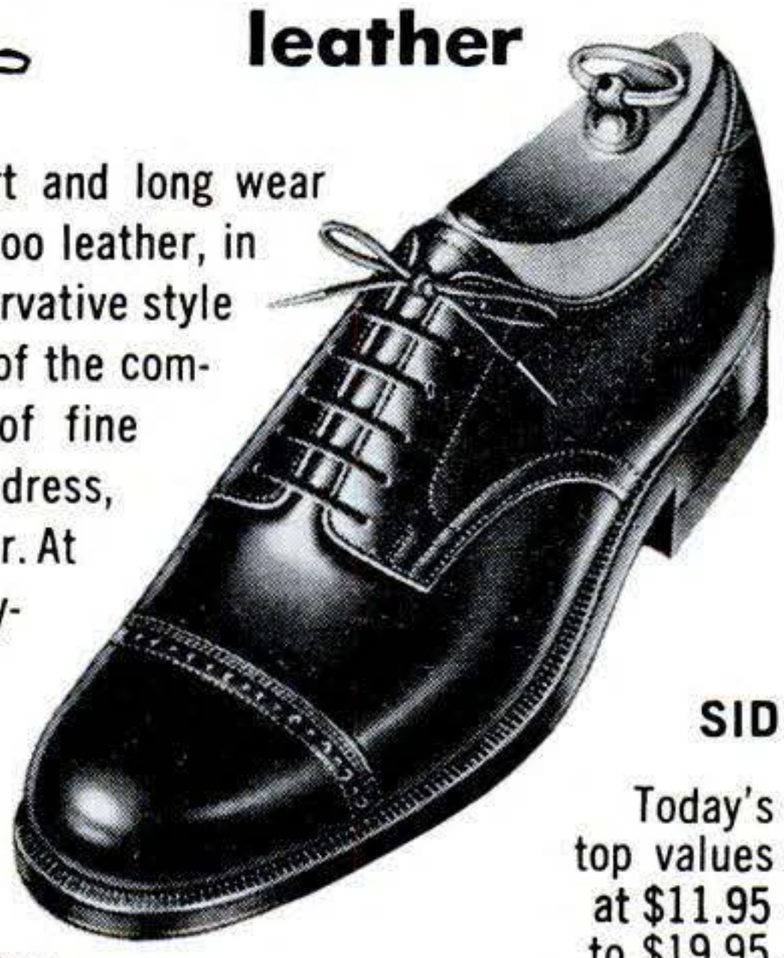

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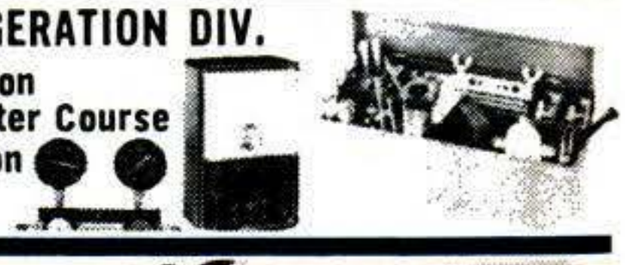

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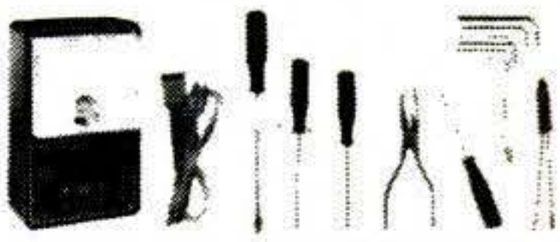

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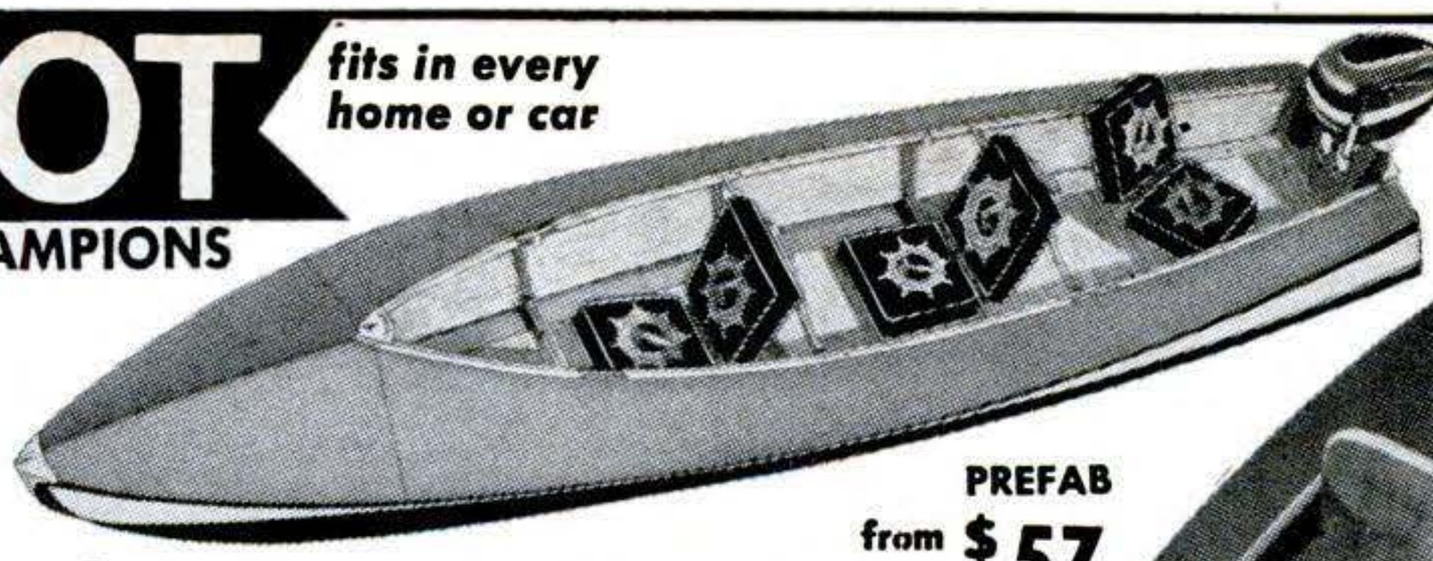

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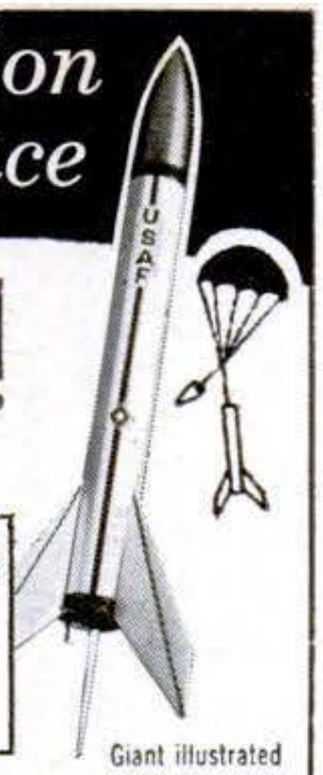

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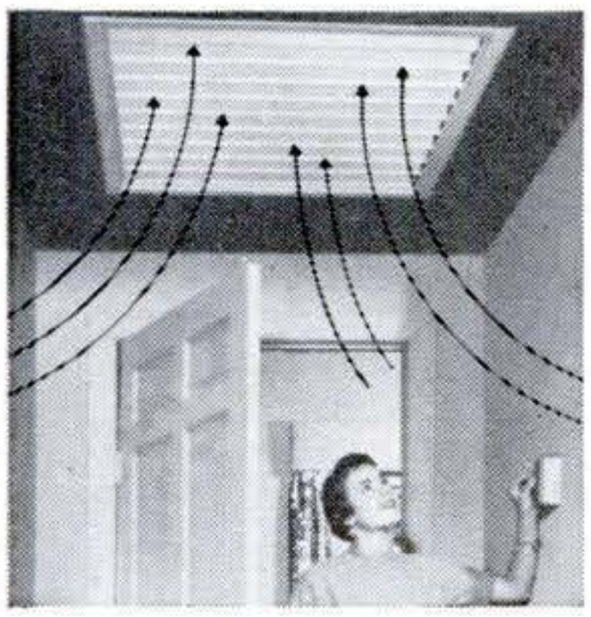

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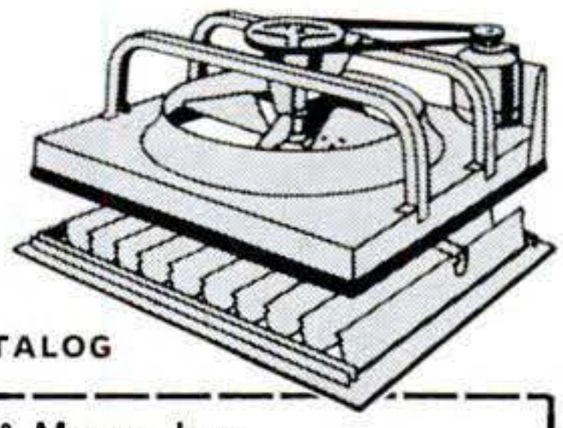

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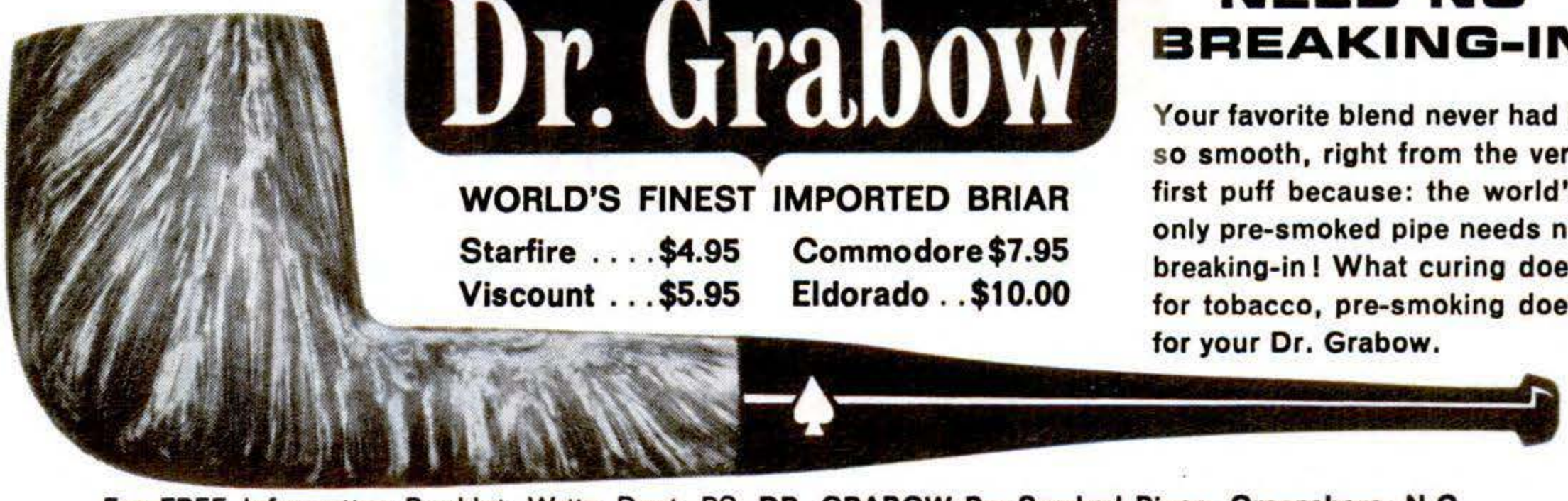

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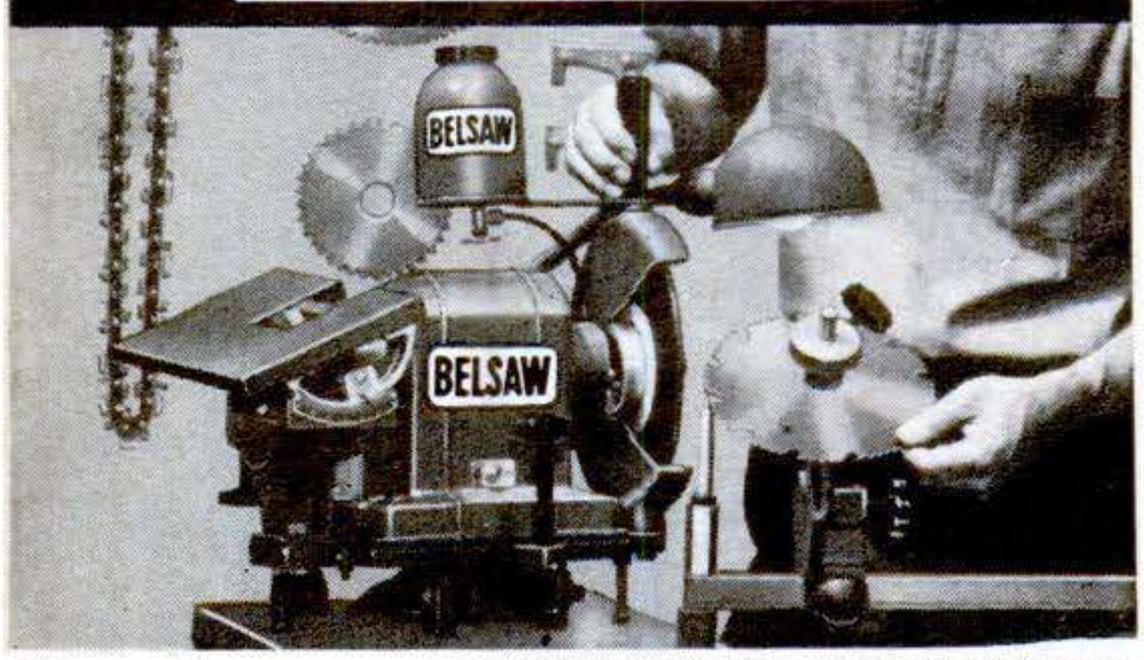

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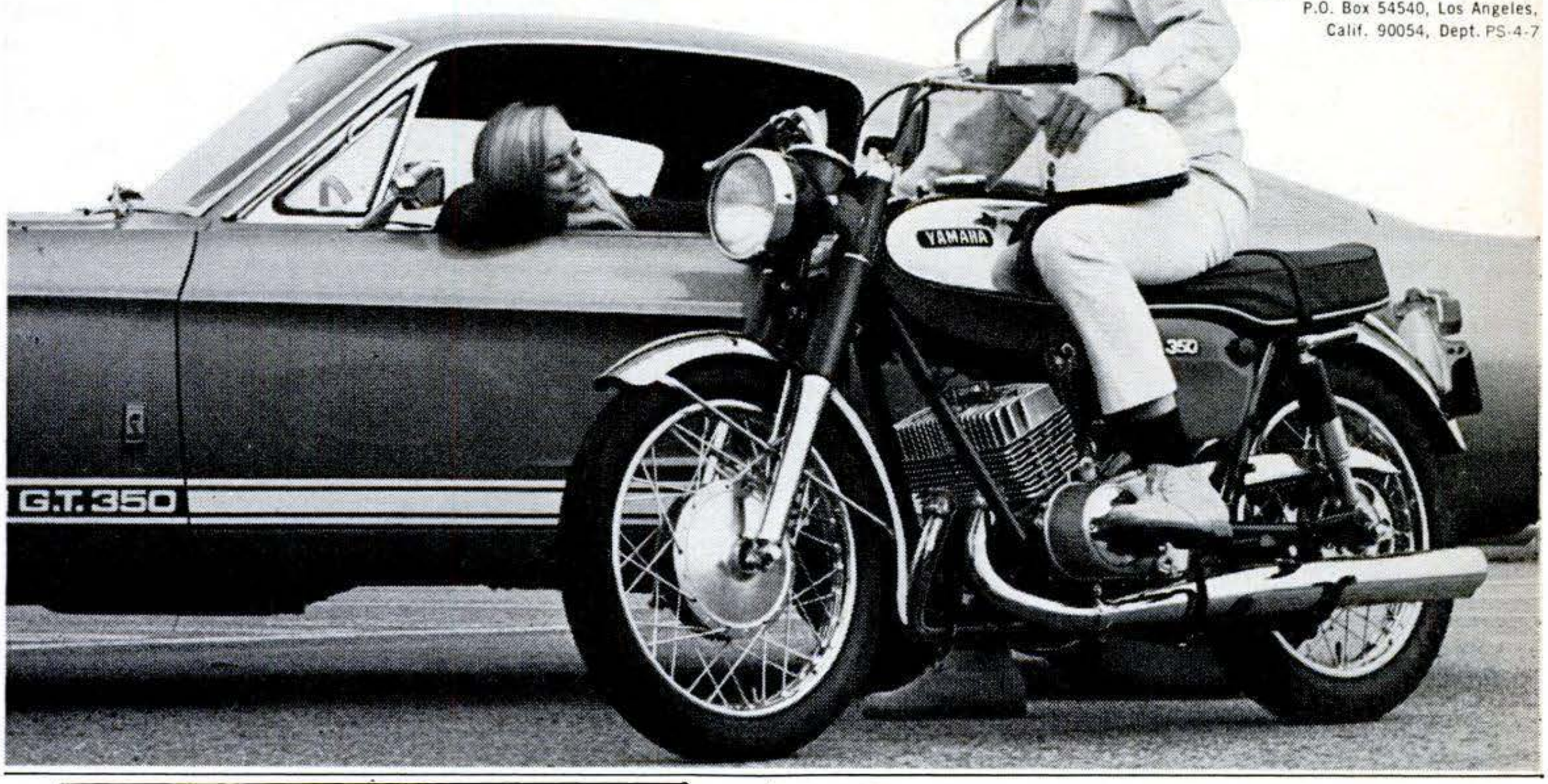

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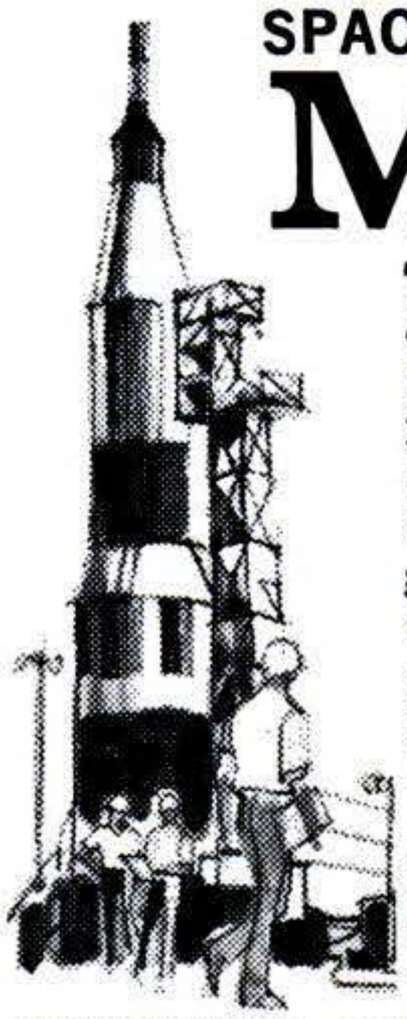

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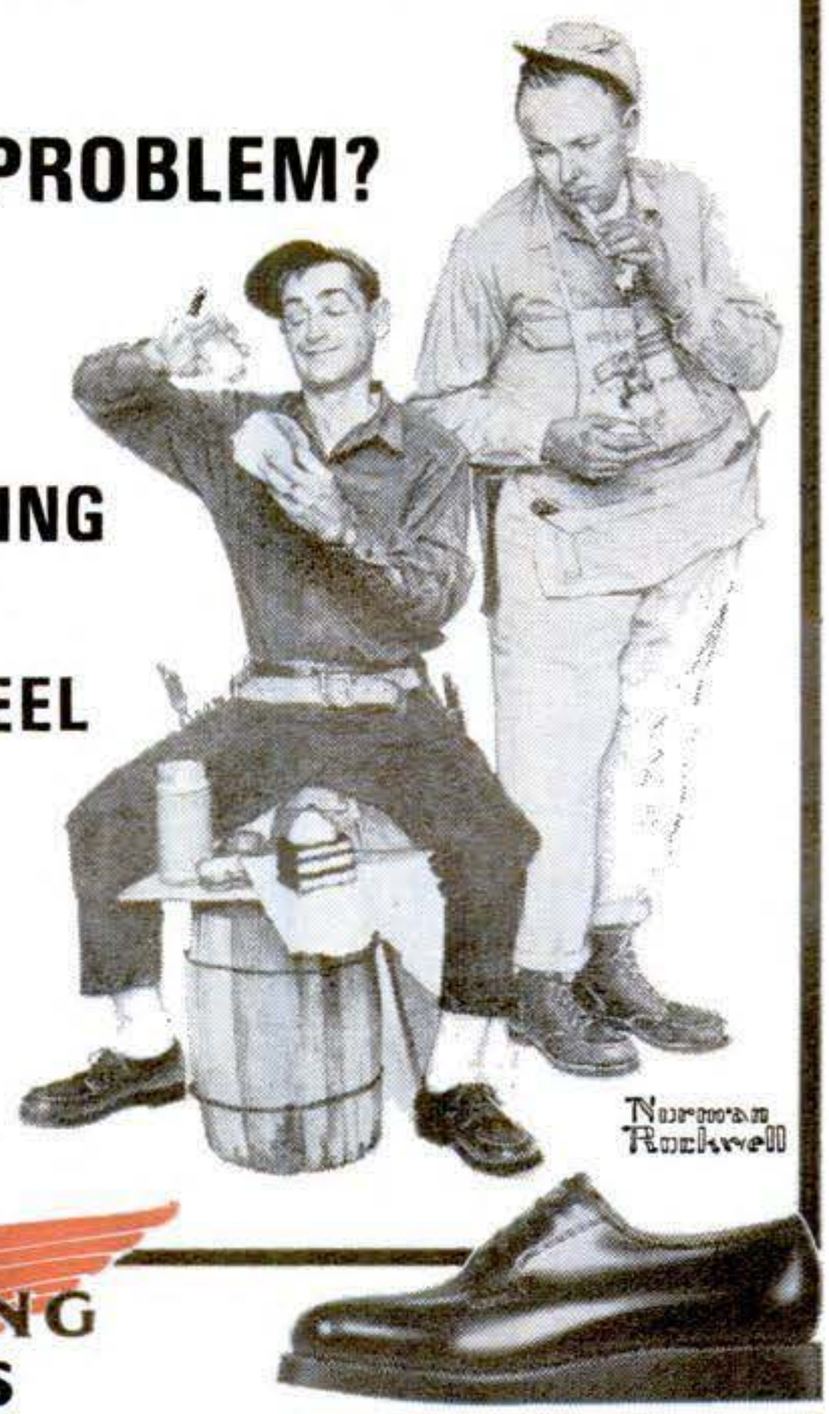

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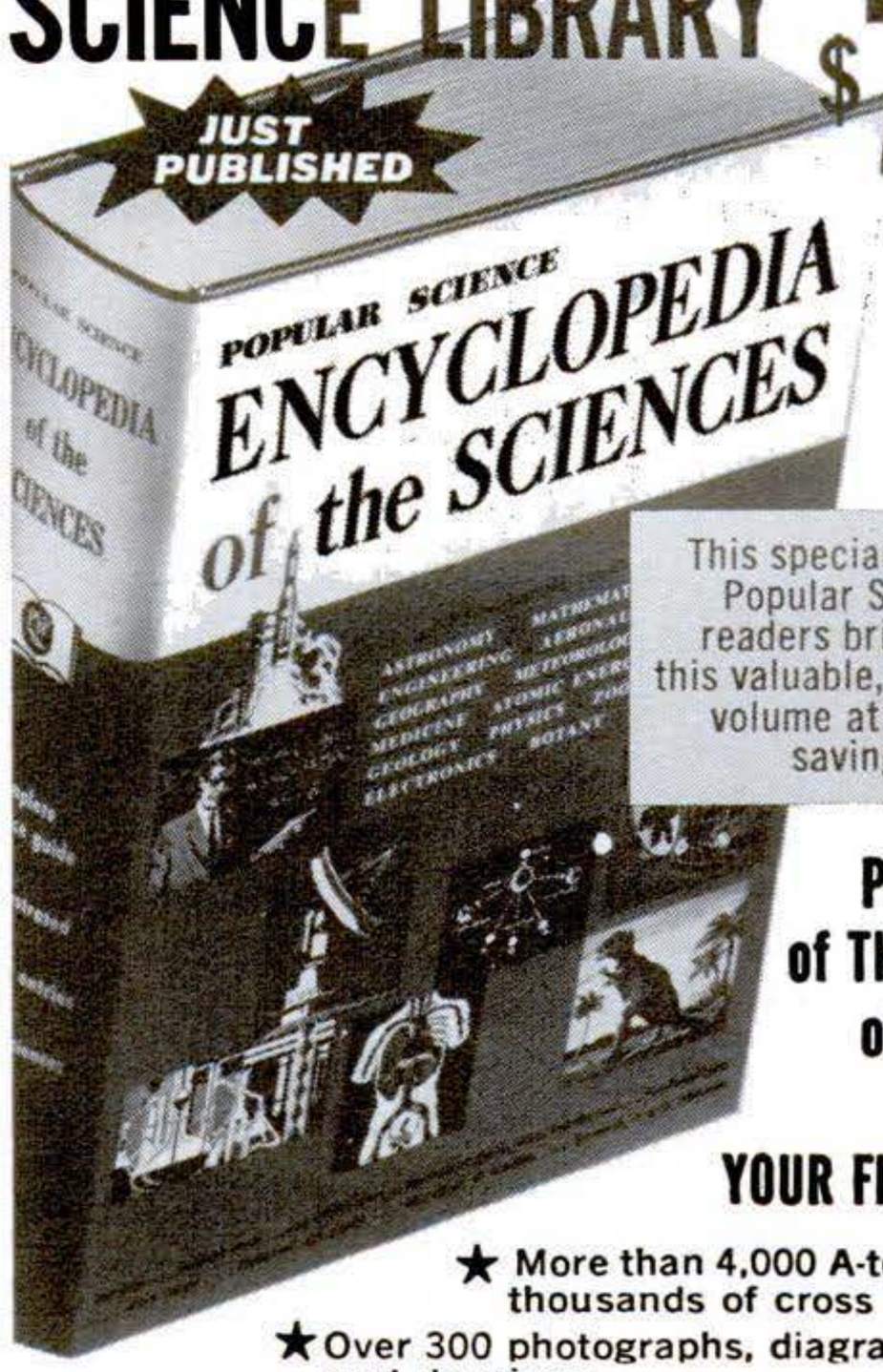

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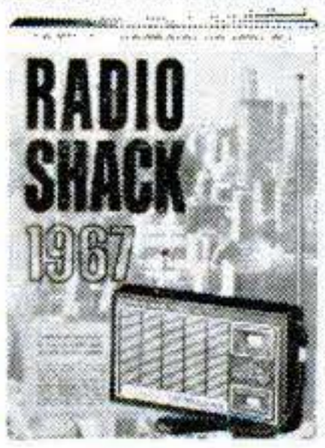

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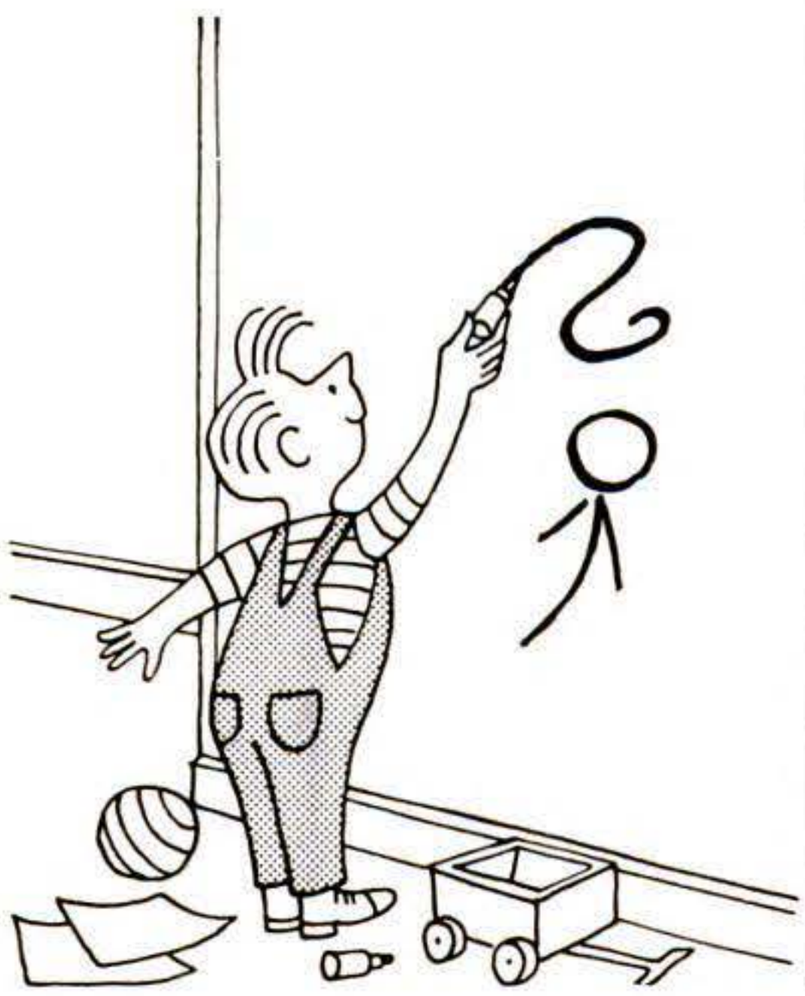
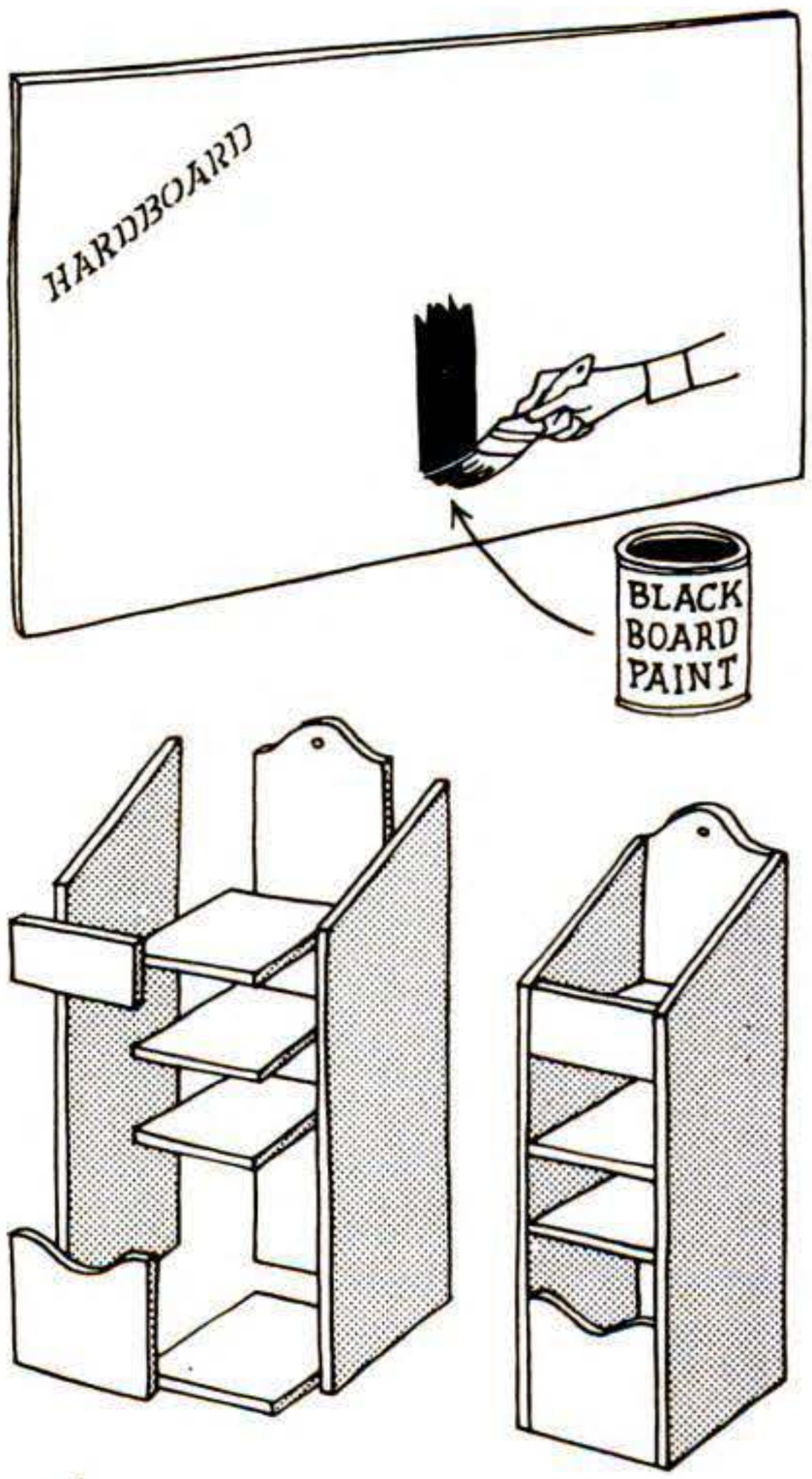
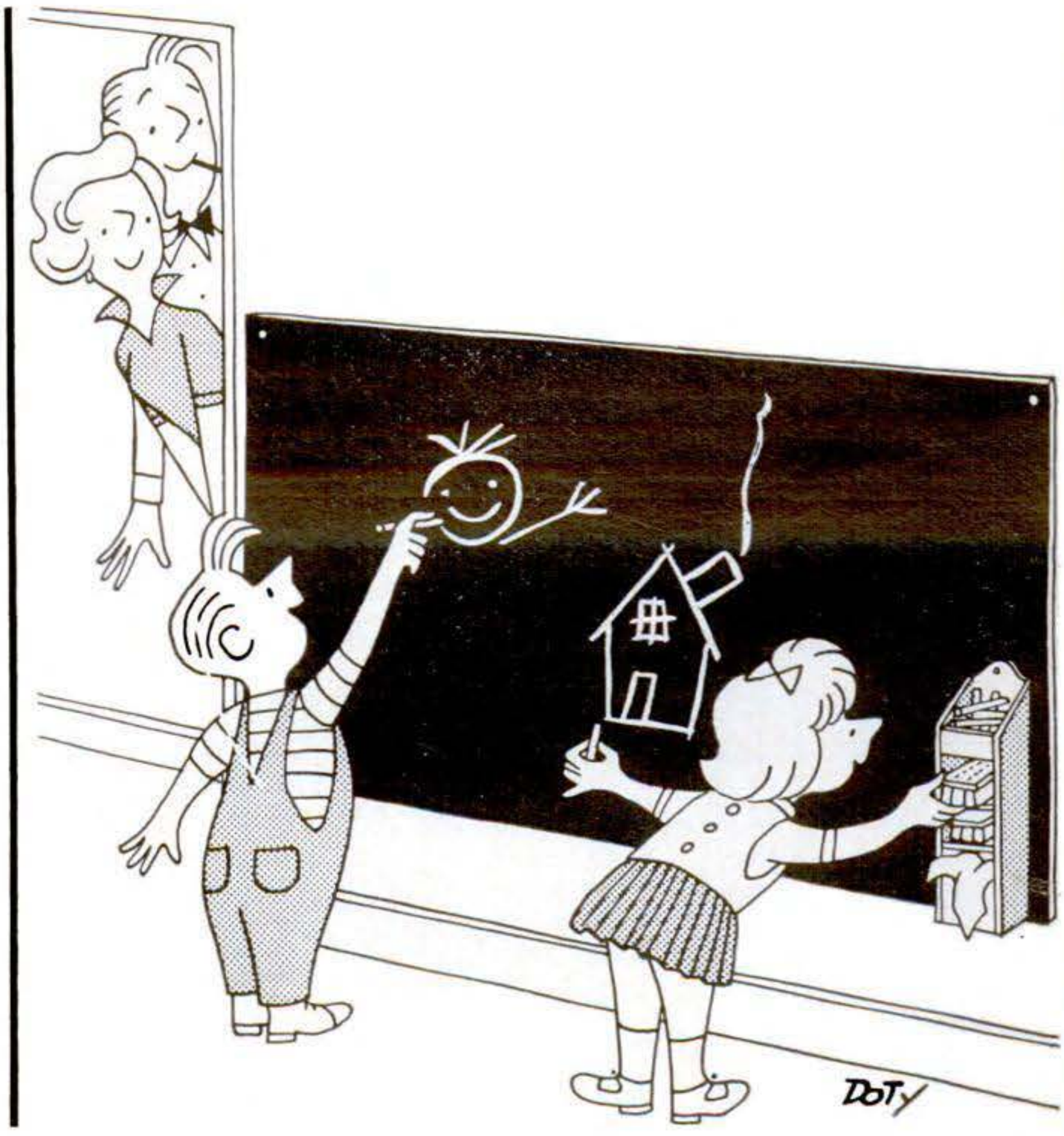
By ROY DOTY







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We can't speak for all of them. But we know one who drives an Allis-Chalmers lawn and garden tractor. Says it's because he drives our big equipment—dozers, loaders, etc.

So, when he needed a garden tractor, he just naturally thought of Allis-Chalmers. Not surprising. It's built with the same toughness and handling ease of our big ones.

We've equipped it with a rugged Briggs and Stratton engine—so powerful you can mow an acre of grass in half an hour, throw 200 shovelfuls of snow a minute, or tackle a dozen other jobs.

And it comes with two-inch padding on the seat, arms and back; and more places to attach more implements.

Ask an Allis-Chalmers dealer to show you his garden tractors. See our new 5 HP Mow-Bee riding mower, too. For more data, send coupon.

PS-4

- ☐ Send me your booklet: "How to Buy a Garden Tractor."
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Detroit Report...

TWO POWER PLANTS IN THE CAR OF THE FUTURE? The auto companies are looking into the idea of making a car with both battery power and a gasoline engine--the electric motor for city driving and the piston engine for highway use. Experts say such a car would satisfy emission-control demands of big cities, yet give the car unlimited range for intercity travel. Battery recharging is simple--an extra generator feeds electricity to the power battery when the car runs on gasoline.

No-emission gasoline engines? Electric-car research directors from the Big Three auto makers say the piston engine holds more promise than electric cars. Ford and GM scientists say they would choose a piston engine if they were assigned to develop a city car with the emission level of a battery-powered car. Chrysler's spokesman on electric power says the turbine is a possibility, too. They agree that the gasoline engine can eventually be built so that it produces no harmful exhaust emissions, and they think they can prove it in less than five years.

Olds uses Climatic Combustion Control option on California cars—instead of the costly and complicated Air Injection Reactor [PS, Mar. '66]. CCC assures constant intake-air temperature by using exhaust heat under thermostatic flow control [PS, Oct. '66]. Olds now plans to use CCC on all its '68 models, when nationwide laws against exhaust emissions go into effect. The system now meets all the requirements of the California smog-control laws. By this change, Olds gets rid of a lot of extra tubing, valving, and high-wear parts under the hood. The saving per car is about $12.

All-plastic cars are on the way—one piece at a time. Oldsmobile says it is now producing a limited number of cars with plastic wheel housings in front fenders on a trial basis. This saves about 12 pounds, and plastic has the added advantage of being corrosion-resistant. Pontiac has been using uncoated plastic grilles for a couple of years, and Buick is expected to come out with a chrome-plated plastic grille on one of its '68 models (probably in the Special/Skylark series). To date, the auto makers have rejected all metal-clad plastics because of peeling in severe wear areas like grilles and headlight rims. Buick may have licked this problem with a new chrome coating process that gives four to five times the adhesion of present metal-plated plastics. But don't expect Buick to make the switch to plastic bumpers just yet.

Ford has dropped the automatic door-lock system that secured all doors when the car reached a speed of eight m.p.h. Why? Because the system was activated in automatic car washes when the rear wheels were spun while being scrubbed. When the car got to the end of the wash, the doors couldn't be opened because the key was still in the ignition switch. If you want to lock all doors on future Fords and Mercurys, you can get a toggle switch. Push down, and all doors lock; up, all doors unlock.

Look for all-new '68 models from American Motors and Lincoln. The new AMC car is a sporty AMX-based model, sized between the American and the Rebel series. Lincoln's new entry is the super-deluxe Mark X, a new competitor in the Eldorado class. Dodge's Charger will be vastly changed for '68. It'll shrink down to Barracuda size and get completely new styling. Extensive restyling is scheduled for the GM and Chrysler Corp. intermediates (Chevelle, Tempest, F-85, Special/Skylark, Belvedere, and Coronet). The new intermediates will have bodies with rounder, smoother lines. Styling changes planned for the rest of the '68s range from full reskinning to minor facelift. Comet and Fairlane hardtops will get full fastback roof lines.

Radial-ply tires will be original equipment on four out of 10 cars by 1970. That's the estimate of a U.S. Rubber Co. official. At least five companies have radials in limited production now, and you'll be able to special-order radials for just about every car next year. It will cost you more: If you pay $20 for the conventional tire on your car, the radial will cost about $28—reasonable for longer life, greater strength, better fuel economy, surer handling, improved traction and braking, and higher speed capacity.

Jim Dunne

Detroit Editor

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The Round Tire

rolls at least 3,000 miles further!

This precision-engraved mold is one reason why!

The mold for The Round Tire, the Atlas PLYCRON*—is made with remarkable precision! It is engraved to within 3/1000 of an inch of perfect round! Other molds can be out of round by as much as 30/1000 of an inch!

This near-perfect roundness is just *one* of the many reasons why an Atlas PLYCRON Tire rolls more smoothly, wears much more evenly, for at least 3,000 extra miles!

FOUR ACTUAL PLIES. The Round Tire has 4-ply construction for greater strength plus many other marks of quality — a unique tread design which puts more rubber on the road—longer-wearing tough rubber compounds. These are just a few of the many examples of the care that goes into building The Round Tire.

SAFETY TESTED. You'll be glad to know The Round Tire is also safety tested in 54 different ways. In addition, complete sets of tires from various manufacturers' production for '67 cars were promptly road tested under identical conditions by an independent test fleet. These tests showed you can expect 3,000 more miles from The Round Tire than from tires that come on most new cars.

Get *your* extra miles with The Round Tire!

ATLAS PLYCRON

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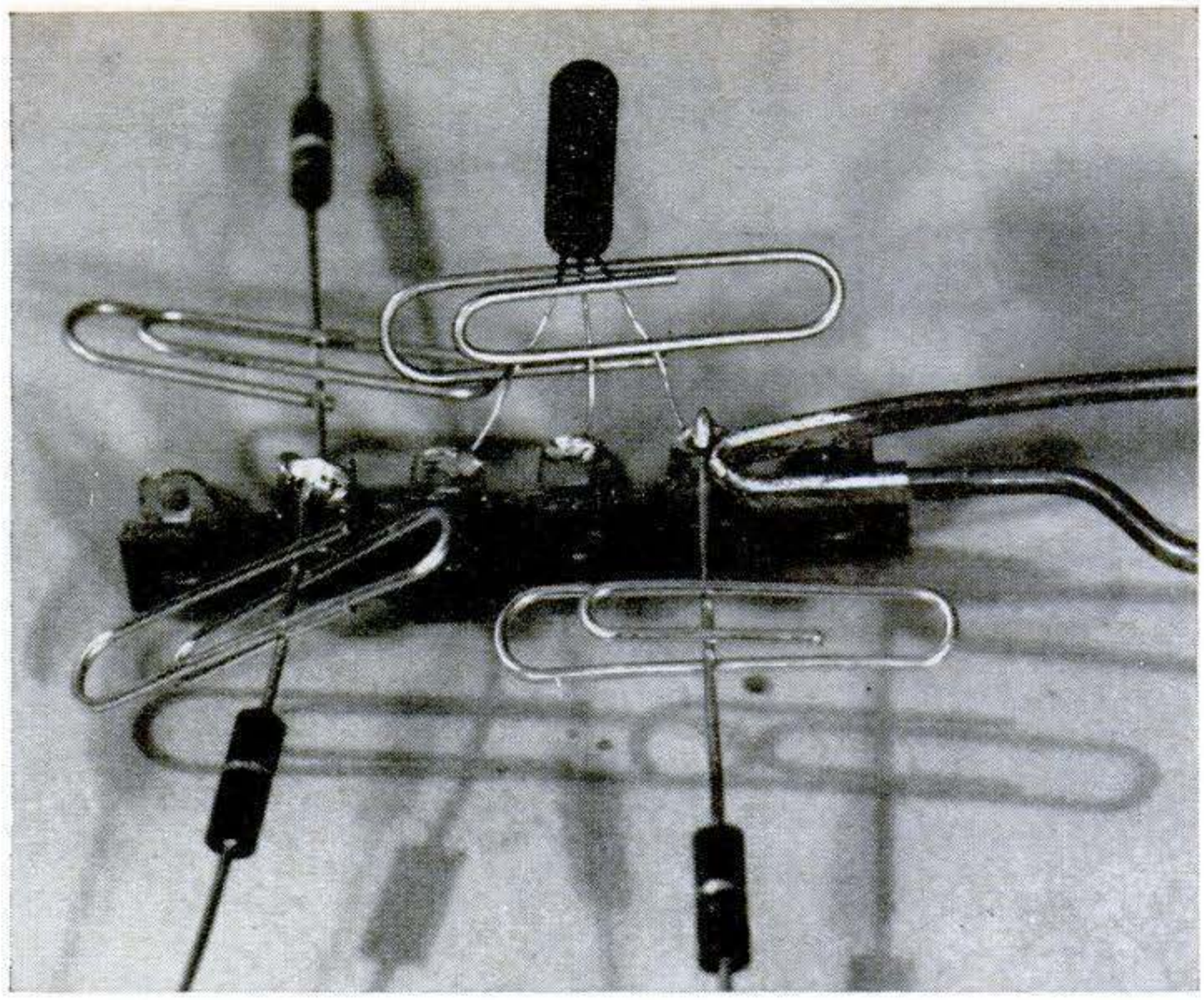
SHORT CUTS AND TIPS

FROM PS READERS

Paper clips insulate small electronic parts

Here's a tip on how you can avoid heat damage to small electronic components while you're soldering. Just slip ordinary paper clips over the leads, as shown in the photo at left. The clips will serve as a heat sink, protecting these easily damaged parts.

KEN PATTERSON
Regina, Can.



Quick way to ground a plug adapter

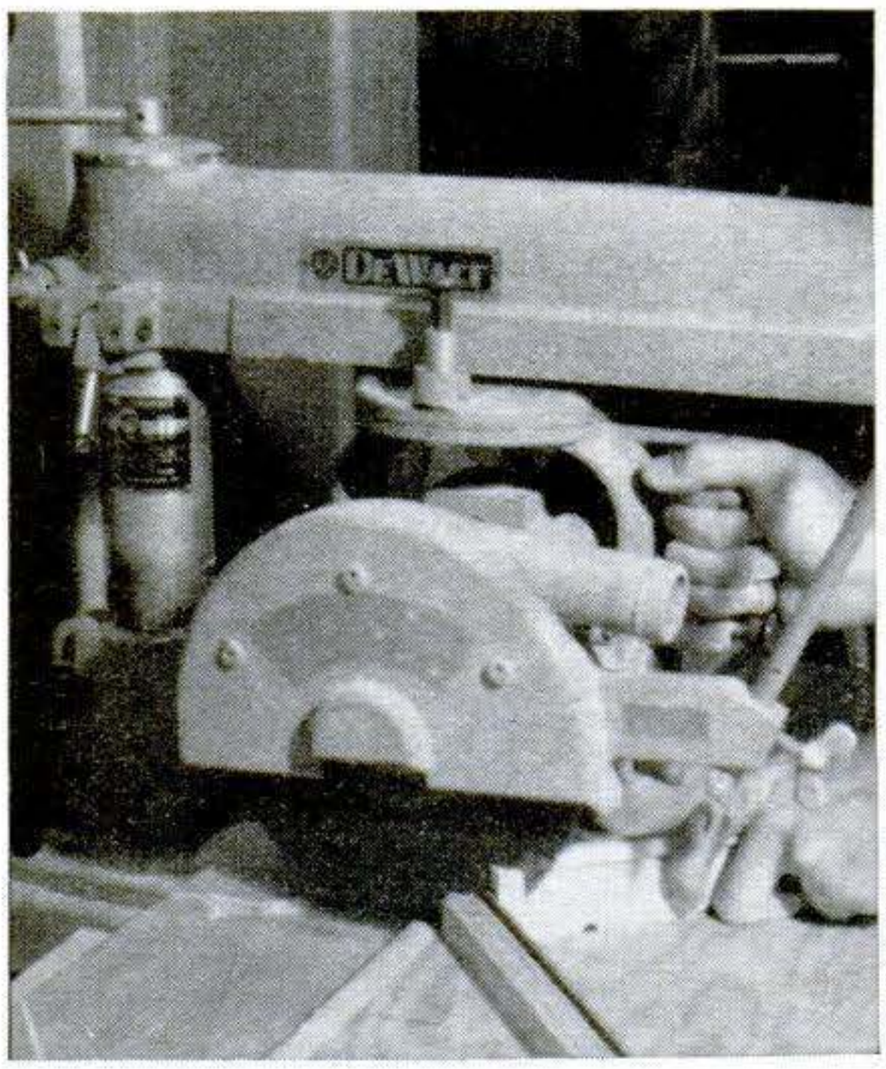
After watching my father move his three-wire plug adapter from outlet to outlet when using his portable power tools, usually neglecting to attach the grounding terminal to the outlet screw, I soldered an alligator clip to the grounding wire. Since all the outlets in our shop have metal cover plates, it's easy to clip the alligator to the plate, thus grounding the tool.

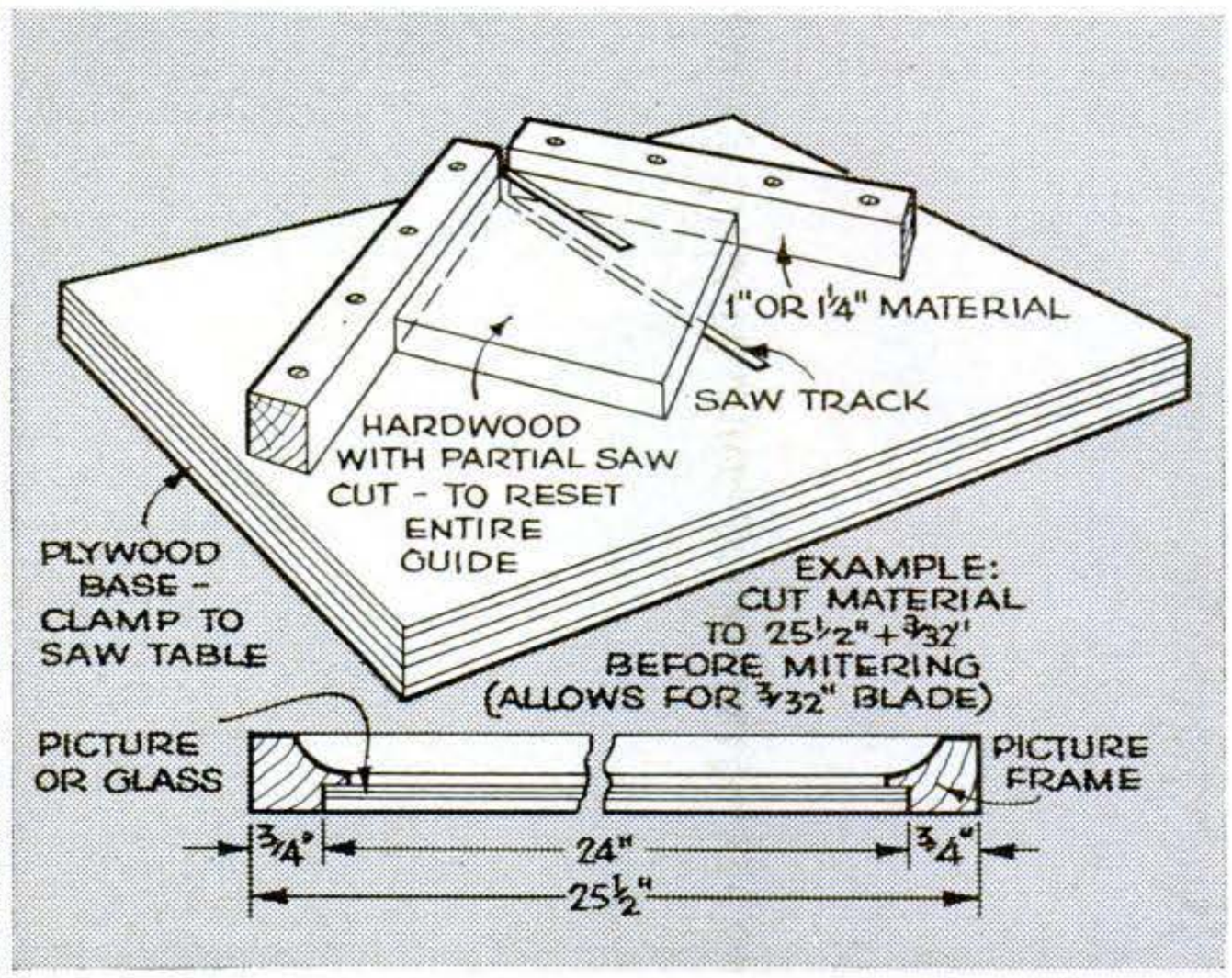
CHRISTOPHER ABBOT, Santa Rosa, Calif.

Waxed paper saves canned paint

Here's a simple way to avoid the nuisance and waste caused by skin forming on the paint in a partly used can. Place a disk of waxed paper on the surface before you store the can. Use the lid to draw a circle the same diameter as the inside of the can. Lower the paper lightly, so that it flattens from the center out. This prevents air bubbles from being trapped under the paper.

DONALD NEWCOMER, Burbank, Calif.





Miter guide improves joint accuracy

A radial-arm saw, particularly a well-worn one, may not reset accurately enough to cut neat miter joints in narrow stock such as picture molding. The jig shown here brings the blade into exact 45-degree position each time. It's made by cutting a saw kerf about 1/16" deep part way across the plywood base. Then you glue and screw two 1"-by-1" hardwood strips at 45 degrees to this kerf. Clamp the jig base to the table with the blade aligned in the track and make a cut part way through a piece of hardwood scrap. Use this scrap in the future to help align the saw blade. When you're mitering picture molding, add the width of the saw kerf to the length of the pieces.

R. G. TUTTLE, Los Angeles, Calif.

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Somewhere there's a surf that's never been fished. Where you never hear a highway sound. Where you can catch the big ones. And you can get there with the big power of the new V-8 INTERNATIONAL SCOUT with all-wheel drive.

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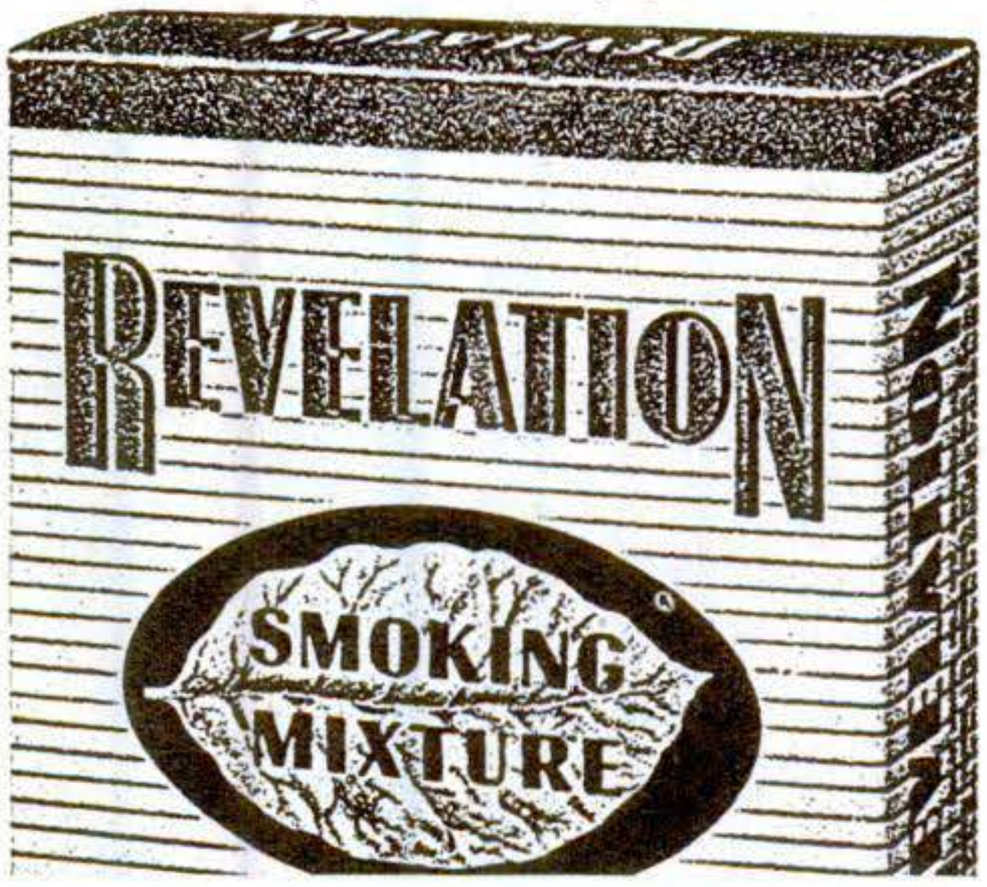
Revelation's not sweet. It's simple. A blend of five great tobaccos. No sugar frosting. Just the *naturally* mellow taste of five great tobaccos, Sam. We make it this way on purpose. Just so you'll stick with us.

for the experienced pipe smoker.



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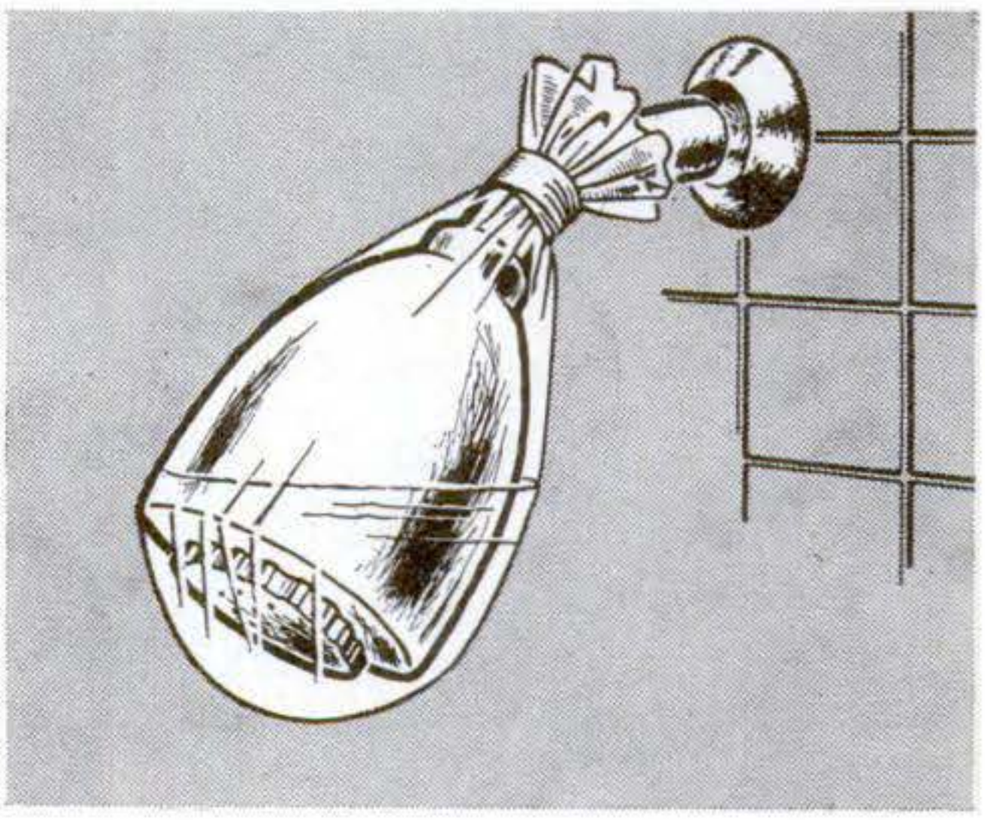
Tip for getting a better finish

A thorough way to clean away dust when you're doing a fine wood-finishing job is to blow through a soda straw. You can direct the blast of air from close to the surface, targeting into crevices and cracks, and lung power provides a great deal of force.

JACKSON HAND, Westport, Conn.



An easy way to clean shower heads

To clean film and mineral deposits from a shower head, try this simple procedure. Put vinegar in a sturdy plastic bag and pull it over the fixture so that the spray holes are completely submerged in the fluid. Secure the bag with a strong rubber band and leave it on overnight. The vinegar will clean the shower head thoroughly and the spray will be much more efficient.

H. H. BULLOCK, Santa Ana, Calif.

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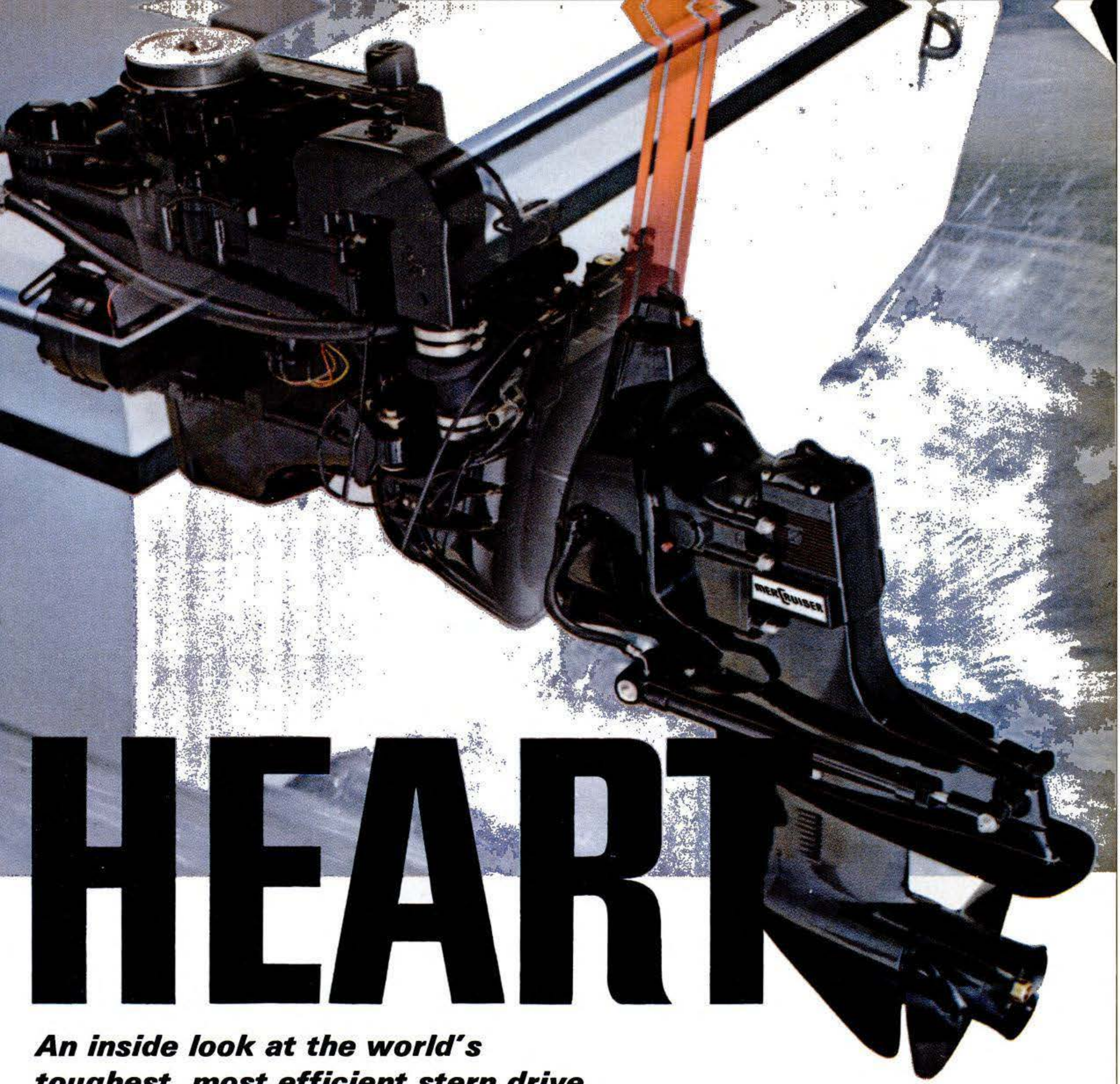

HEART

An inside look at the world's toughest, most efficient stern drive.

Rugged MerCruiser power speaks softly: rubber-mounted engine, neoprene coupling between crankshaft and drive unit plus Jet-Prop exhaust make this the quietest stern drive ever built. And MerCruiser carries a big stick: performance-proved engines geared to take bigger props for tremendous low-speed thrust and high-speed efficiency. MerCruiser is built to last, with lower unit housing die-cast of one piece of high-impact aluminum—no nuts, bolts, screws or gaskets. Rugged shearproof drive eliminates vulnerable shear or drive pins. And MerCruisers with Jet-Prop exhaust require only one hole through the transom: it's a stronger, neater, leak-free installation. MerCruiser is tough, but responds instantly to the lightest touch on its single-lever throttle and shift control. And new Power Trim hydraulic system (optional on 120, 160, 225-HP models) lets you trim your boat while under way with the flick of a dash switch. MerCruiser '67: *engineered to stay ahead:* 60, 80, 110, 120, 150, 160, 225, 325, 475 HP—plus 60-HP diesel. See your MerCruiser dealer, or write for '67 catalog to Dept. PS-4A, Kiekhaefer Corp., Fond du Lac, Wisconsin.

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than all other stern drives combined

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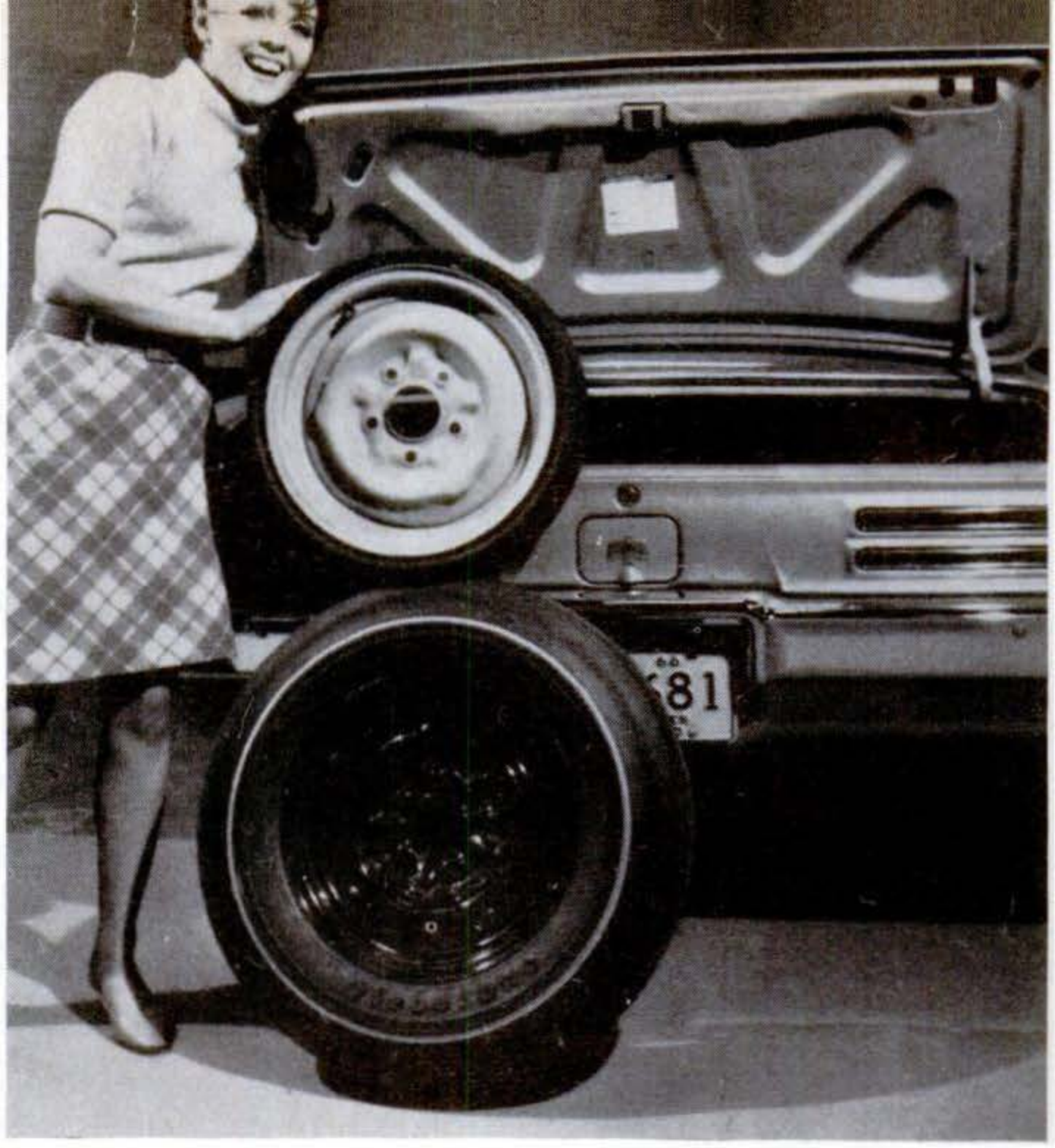
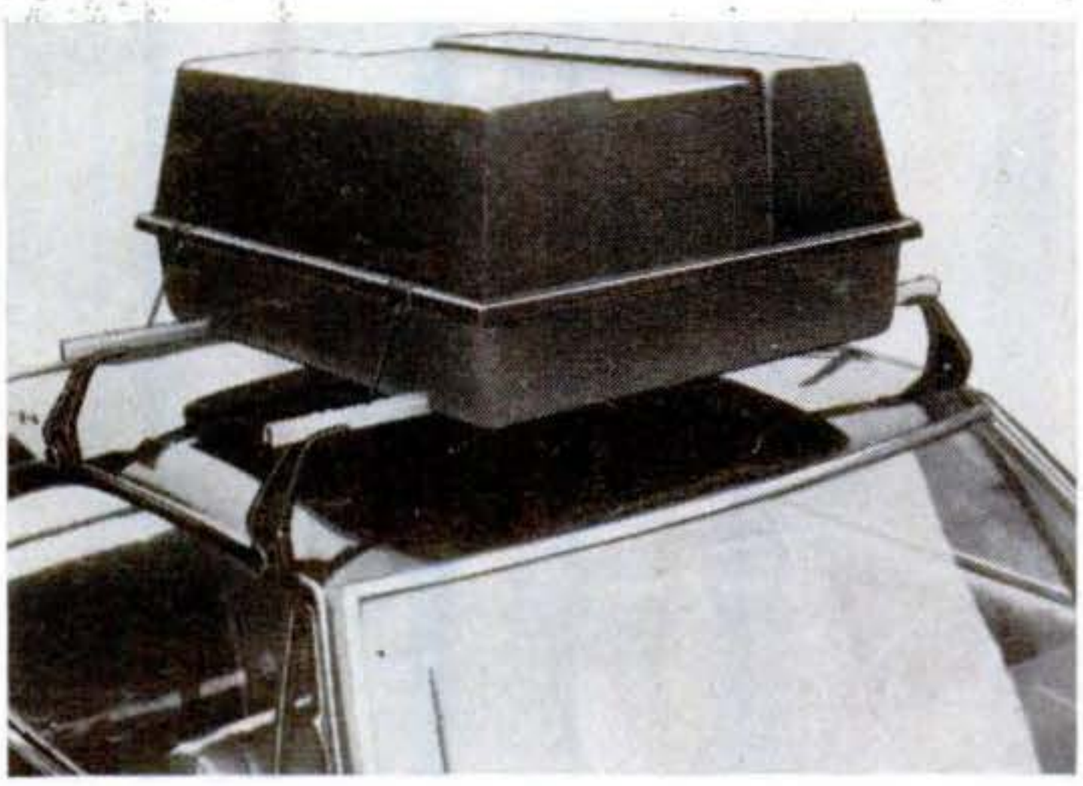
WHAT'S NEW

FOR YOUR CAR

Uninflated spare stores in half of normal space

Here's a halfway step towards eliminating the spare tire and getting more useful trunk space while retaining the reassurance that a spare wheel gives. B. F. Goodrich has developed it, and Pontiac has standardized it for the new Firebird. Space saving is 50.7 percent for a 6.95-by-14 tire; 59.6 percent for a 9.00-by-15 tire. The tire folds up into the rim when the air is let out; takes normal shape when inflated. It's said to be good for at least 1,000 miles and can be reused as often as needed.



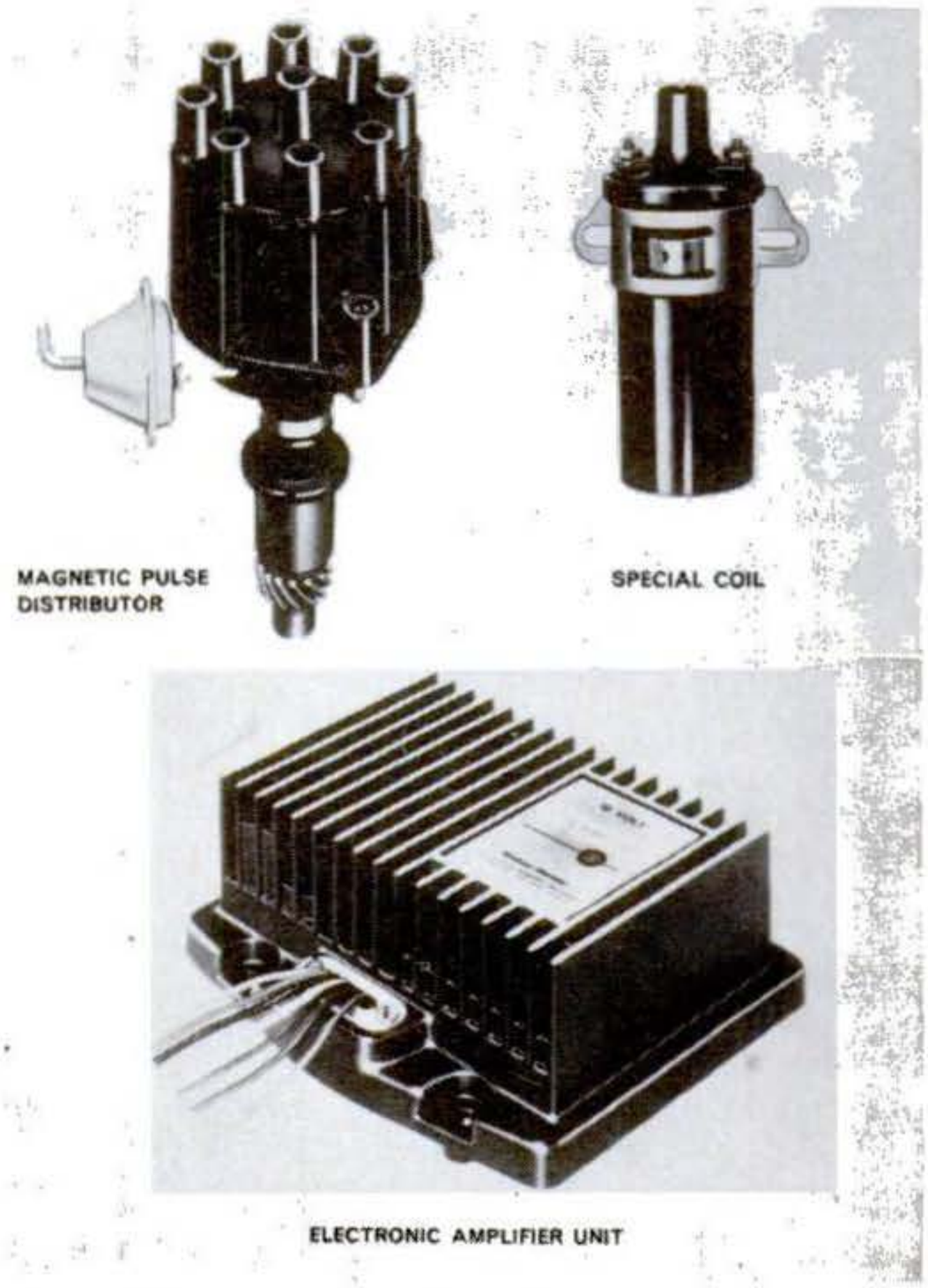


Hard-shell covered car-top carrier

This heavy-duty, high-impact, molded-plastic shell protects against rain, dust, and dampness. Clamshell 700 measures 42 by 36 by 16 inches. Market Forge Co., Everett, Mass. 02149.

Aerosol can for auto-top spot remover

This convertible-top cleaner is not just for soft tops; it also works on vinyl and other fabric or synthetic materials in soft and hardtops. Just spray it on, then rinse it off with water. $1.65. Westley Industries, 1898 Scranton Rd., Cleveland 13, makes it.



New capacitor-discharge ignition system

Delco-Remy's new CD ignition system, GM says, delivers about a third higher voltage to the spark plugs than other transistorized systems. Other claims: up to four times the spark-plug life, improved starting when cold and after flooding, better high-speed performance.

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This is a GM Original:
It calls signals
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You've seen one . . . you've seen them both. GM Replacements look, act and are just like GM Originals.

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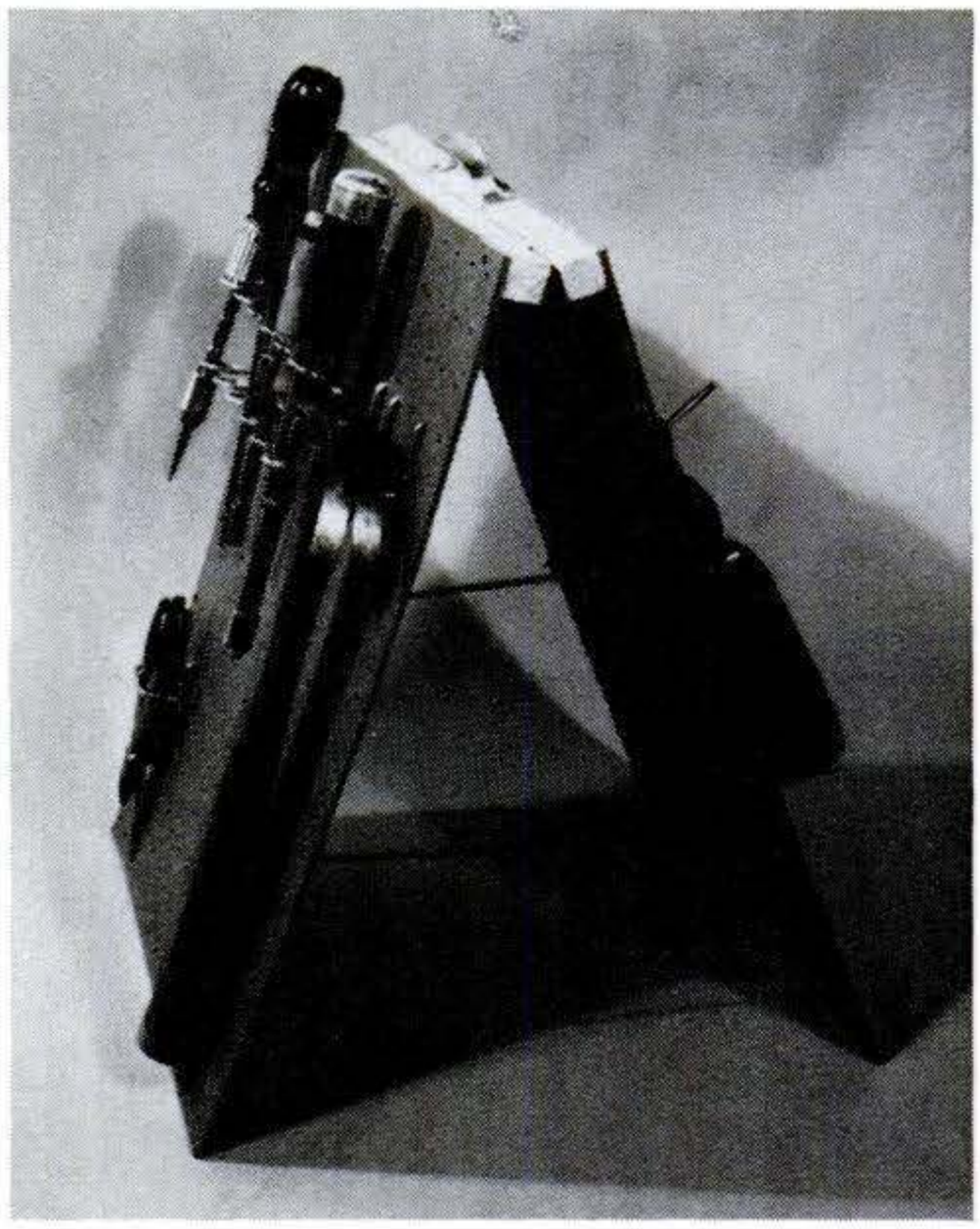
SHORT CUTS AND TIPS FROM PS READERS

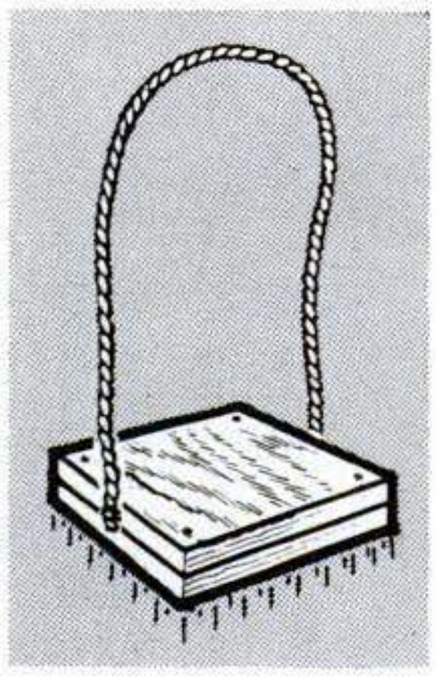


Tote your tools on a tote board

This tool tote keeps your tools handy for jobs around the house. Use two pieces of perforated hardboard. Nail the top edges of each side panel to ¾" strips and join with two small hinges. Add a carrying handle at the top and a light chain to keep the sides from spreading apart too far.

KEN PATTERSON, Regina, Sask.

Simple aerator lets your lawn breathe



The health of your lawn will be benefited by aeration. Here is a simple and inexpensive tool for the job. It is operated by your own foot-power. Two pieces of scrap lumber, a length of rope, and a few dozen eight-penny nails are all you need. Drive the nails through one piece of lumber, and nail the other piece on top. This will prevent a nail from driving back if it should strike a rock. Knot the rope ends and nail them to the unit. The rope should be long enough so you don't have to stoop. Use the aerator by stepping on it and pulling it up.

S. K. SCHWAB, Cokeville, Wyo.

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Will you help our country keep a promise?

America promised freedom to the immigrants who came here not so long ago. And still come.

They, in turn, promised America hard work, ingenuity.

They kept their promise. America has thrived on it.

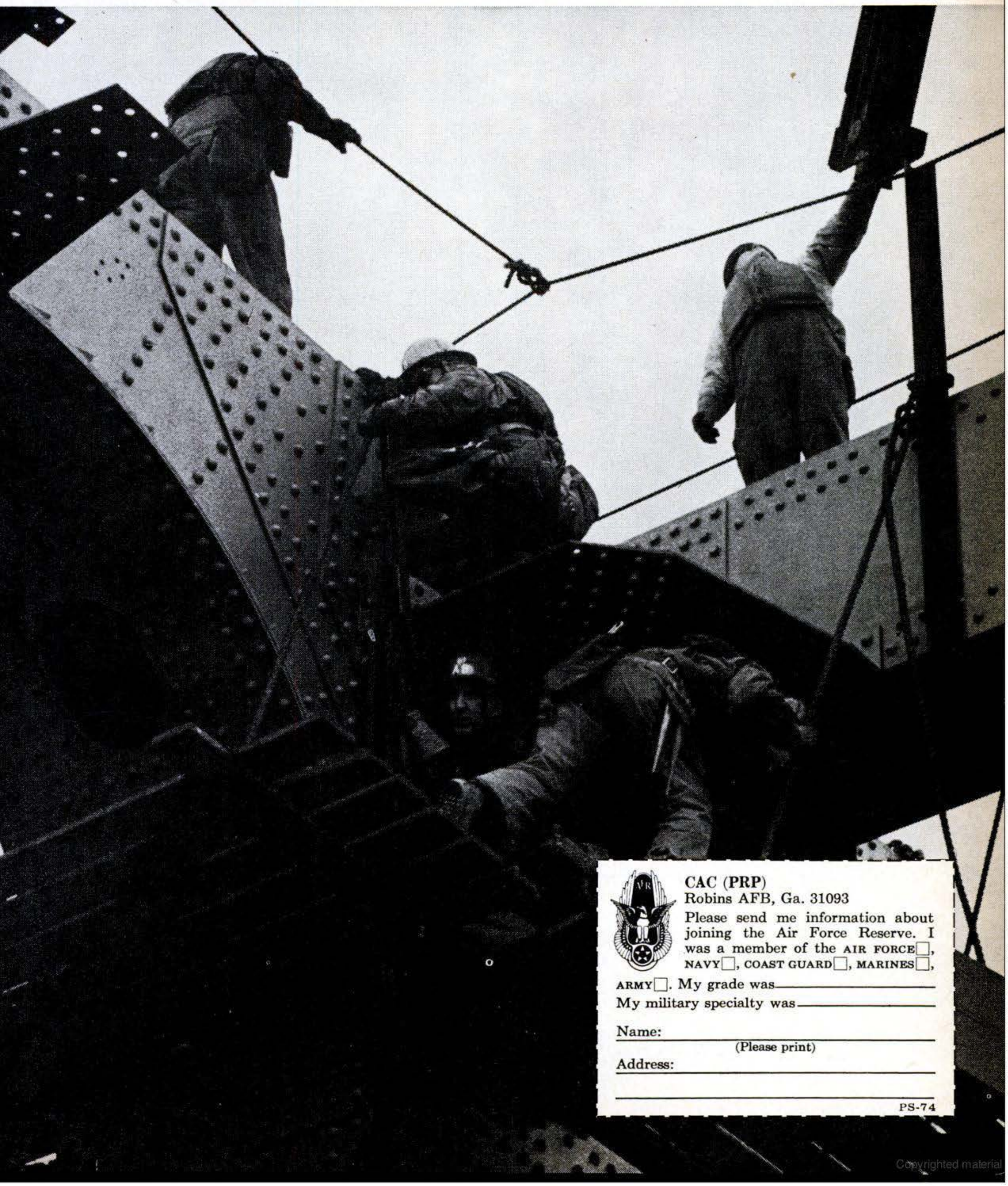
How's America doing lately? Still a land where individual striving means a lot?

You can help keep it that way by joining the Air Force Reserve. The Reserve urgently needs pilots, navigators and panel engineers. It won't take much time out of your life...one weekend a month, plus two weeks a year...and it's your opportunity to continue flying. A welcome little change from your daily routine at home.

You also get paid for it. This isn't bad when those extra bills come in. You also pile up added time toward promotions and retirement benefits.

For further information, visit the nearest Air Force Reserve unit or contact the Reserve Affairs Officer at the nearest Air Force base. For information on the nearest Reserve unit, send in the coupon below.

Help America keep its promise.



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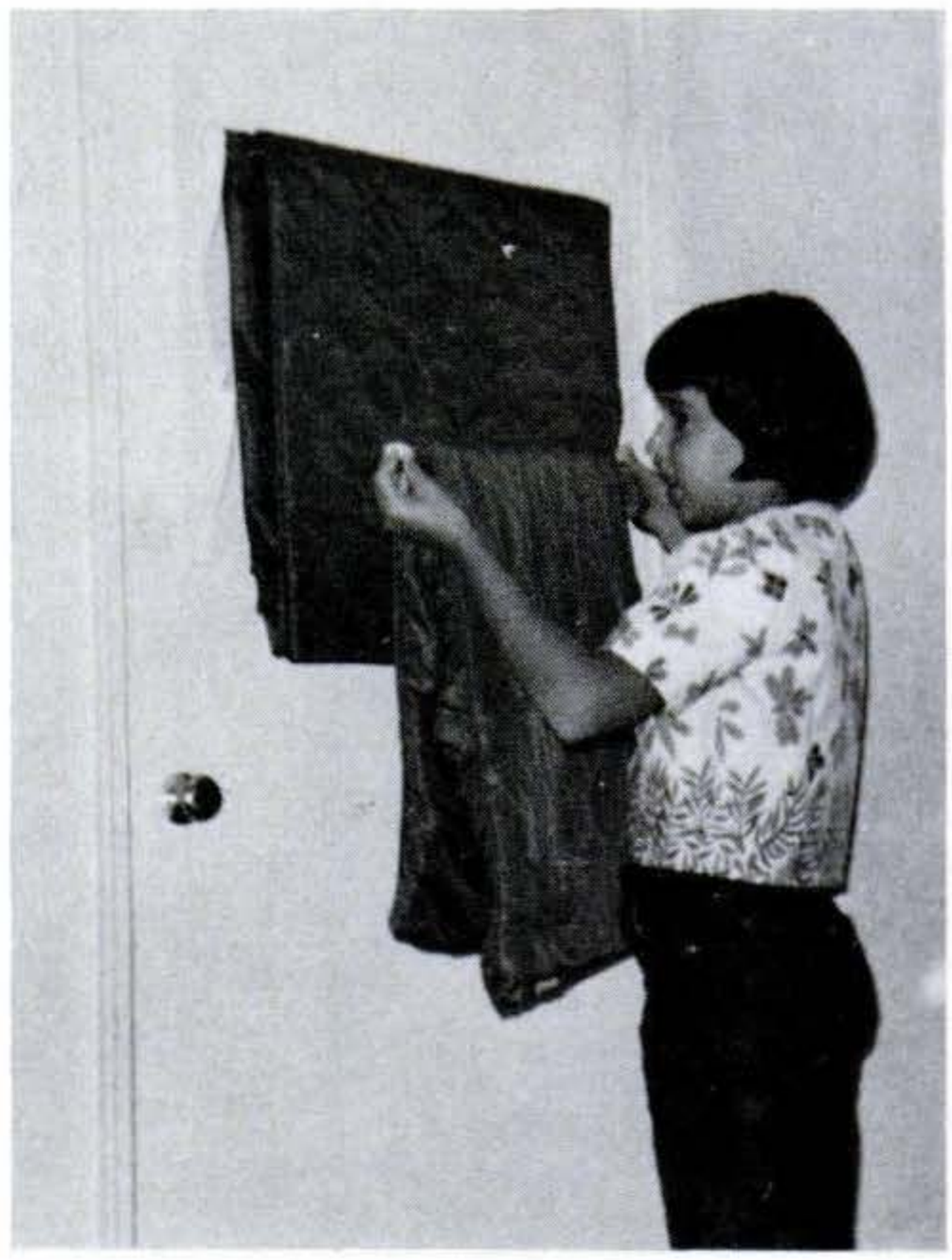
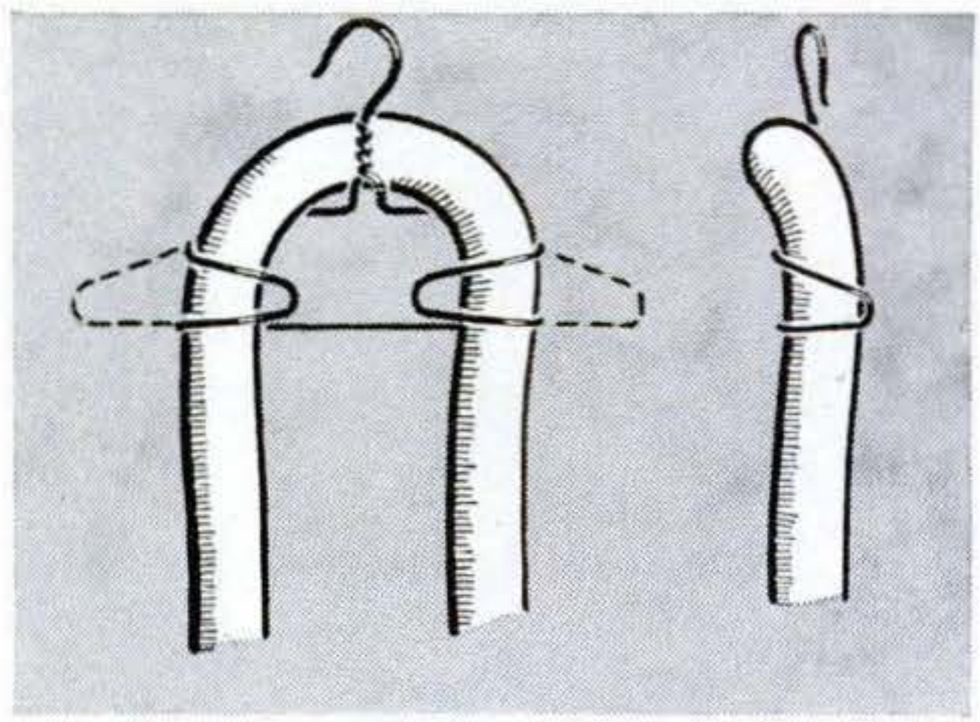


What do you do with a bedspread?

The wooden rack I made for hanging up a bedspread at night is also a handy place to store an extra blanket for those unexpectedly cool nights. It's simple to install on the back of the bedroom door. I made ours from ¾" stock, spacing two scroll-shaped uprights 24" apart. Two removable ⅝" dowels fit in slots cut in the front edges of the uprights. Each dowel holds a blanket or bedspread.

WILL HEAGY, Rockville, Md.



Hanger for vacuum-cleaner hose

Bend a wire coat hanger as shown above and you can hang a vacuum-cleaner hose neatly out of the way in a closet.

D. J. MICHAELOFF, Los Gatos, Calif.

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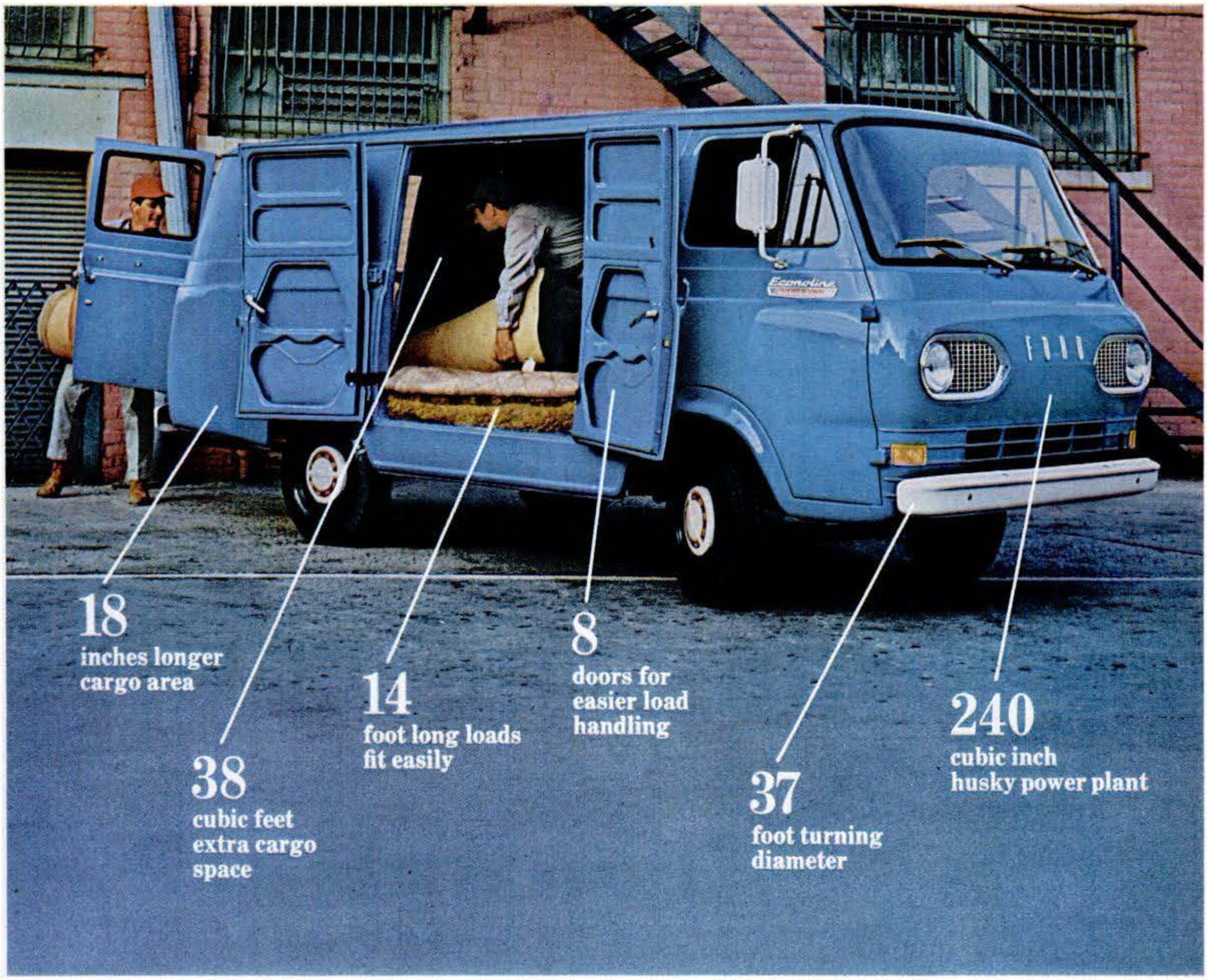
How to win the numbers game:



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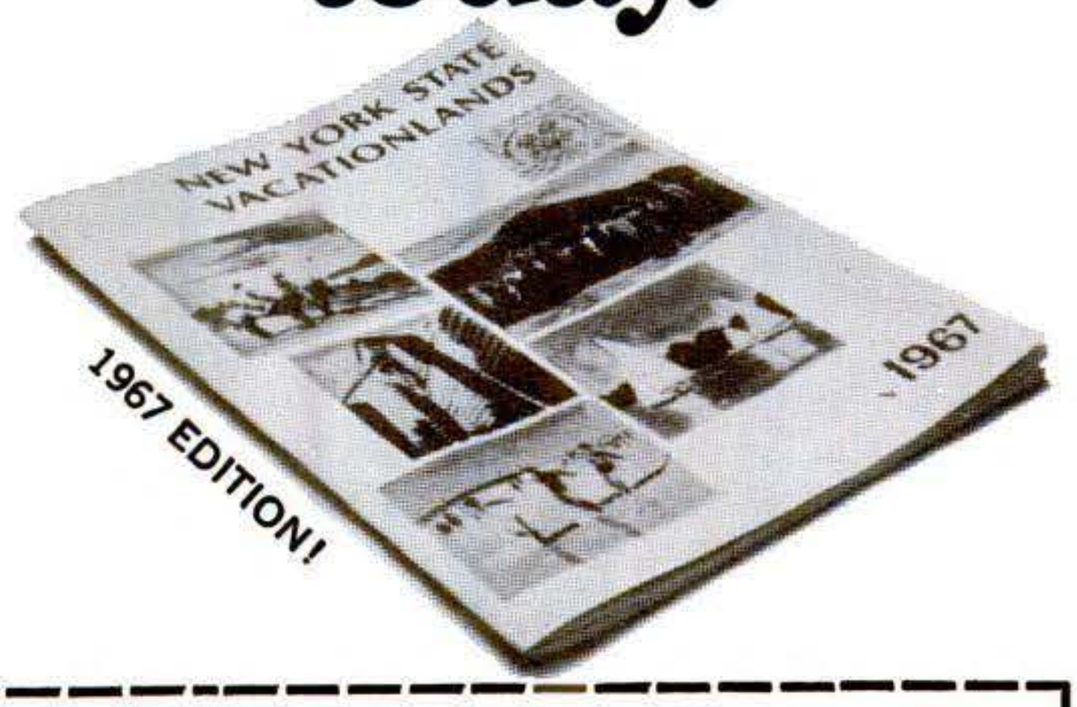

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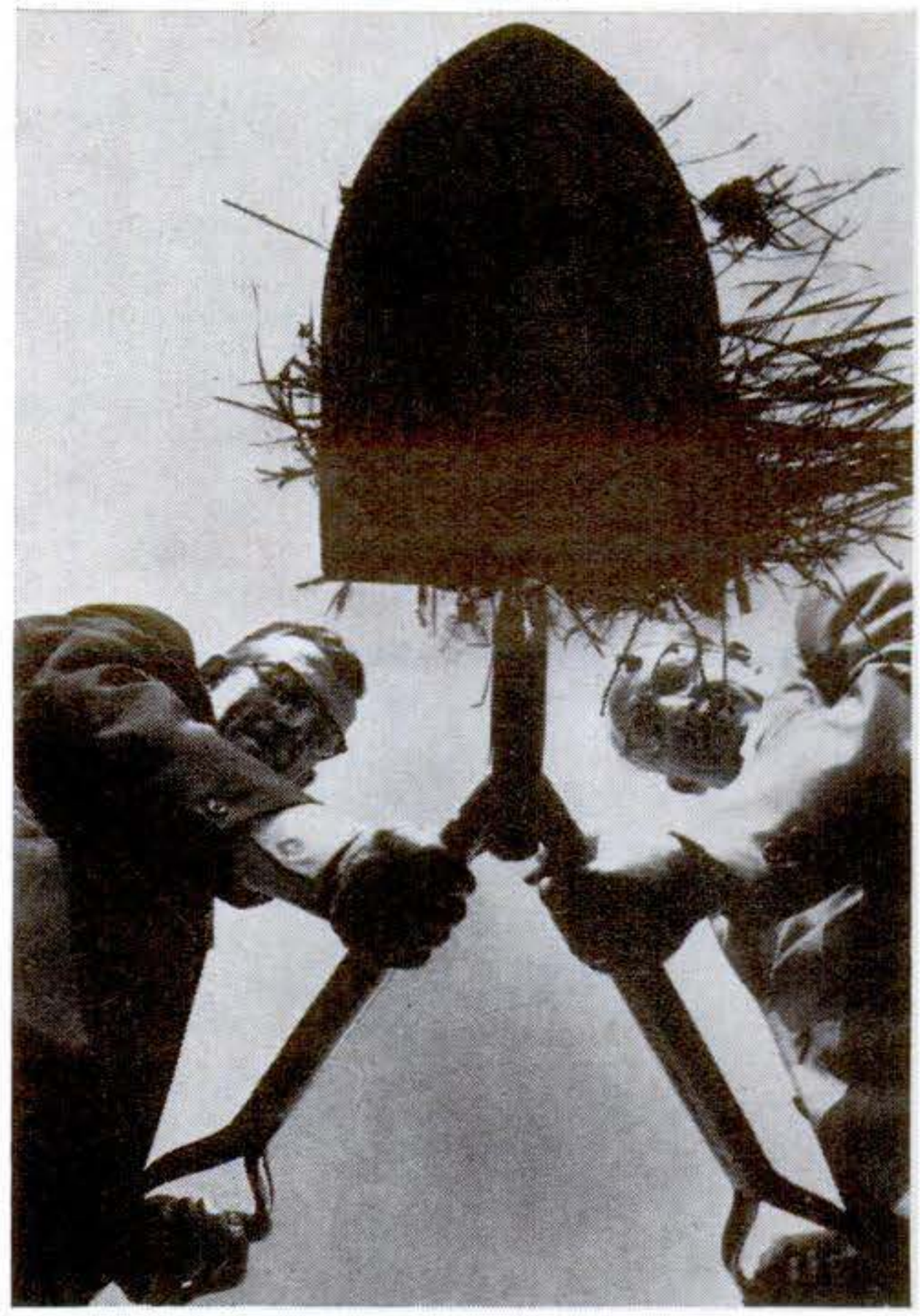

Dig that crazy two-handled spade

The Hoover Co. couldn't decide who should have the honor of turning the first spade of earth in ground-breaking ceremonies for a new plant at Burlington, Ontario. So it made a two-handled spade to let W. A. Munz (left), vice-president, and Gordon Blair, local development director, share the job.

Selling gas by vending machine

You can buy gasoline by the pound in this round-the-clock service station in London. You put a one-pound ($2.80) bill into the machine and after the money is electronically inspected by photocells to weed out forgeries, the pump delivers the gasoline.

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How to mix and be popular

Start with 7-Up.®
Bracing. Crisp. Compatible.
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End up with the most
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FORWARD! Engage the full power forward control and away you go.

STOP! Just release your grip on the handles and Roticul stops on a dime.

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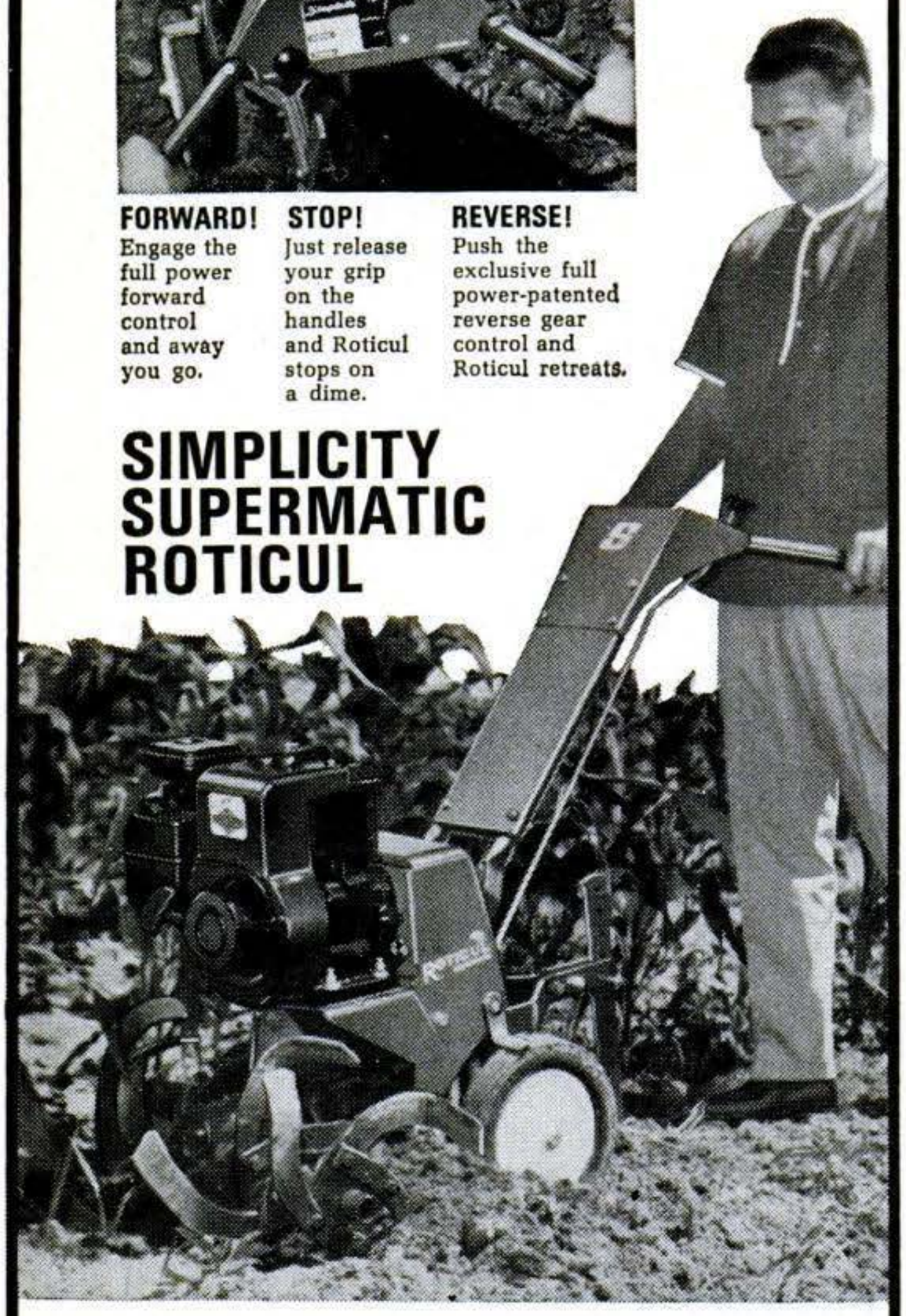
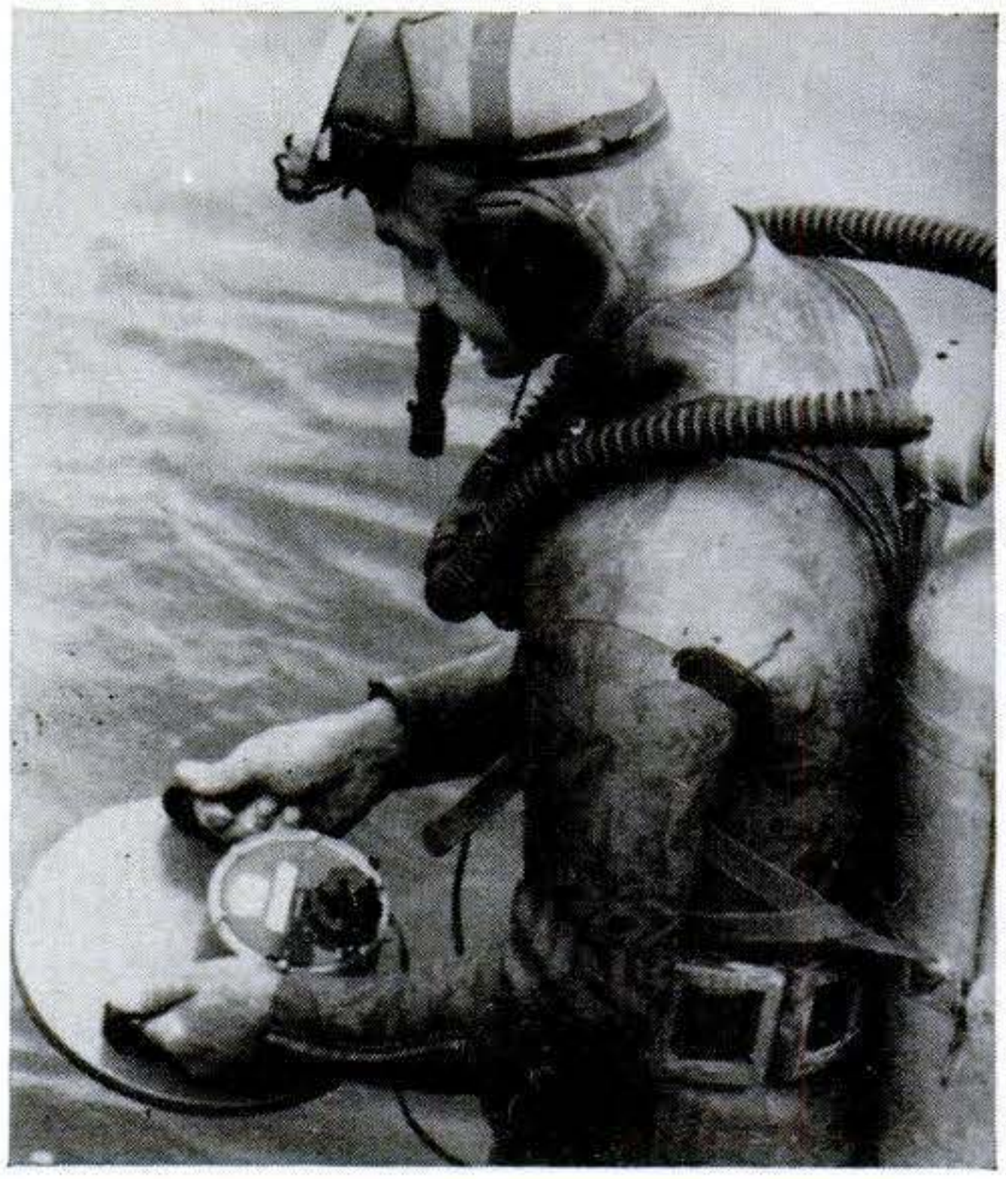
SIMPLICITY SUPERMATIC ROTICUL



This Roticul team comes with five or four horses. Either way, it has the muscle to perform efficiently and tirelessly even in baked, crusty soil. Roticul is so perfectly balanced that even the lady of the house can handle it with ease. ▪ Roticul's self-sharpening, high-carbon steel tines slice into the hardest soil up to 7″ deep and up to 36″ wide. They gently knead the soil with a smooth, spading action . . . leaving it crumbly and perfect for planting. ▪ A 3 hp Economy Model Roticul is also available. See all three Simplicity Roticuls at your nearby Simplicity Dealer. Ask for a performance-proving demonstration.

Simplicity

Simplicity Manufacturing Company, Inc., 6727 Spring St., Port Washington, Wis.



Treasure detector for skin divers

This new fully transistorized metal detector is designed for use by skin divers in search of sunken treasures. The waterproof, battery-operated device is made for use down to 100 feet. It can detect gold, silver, copper, and other conductive metals. The Nemo detector is made by The Radiac Co., Box 657, Center Moriches, N.Y. 11934. The price is $250.

Bed has built-in wake-up shake

It's a rough way to start the day, but if you find it tough to get up in the morning, this might be just what you need. Recently demonstrated in Cologne, West Germany, this bed has a motor that starts shaking it at a preset time, and works until you get out.

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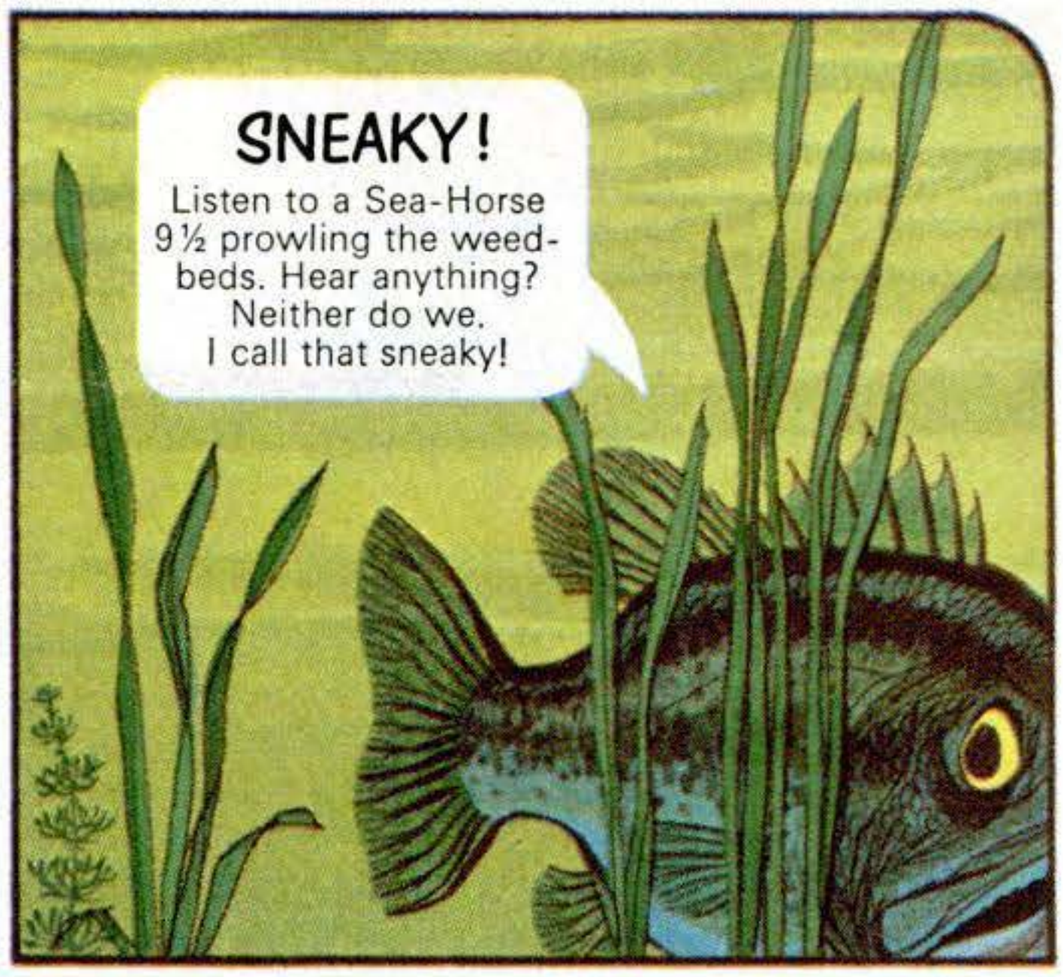
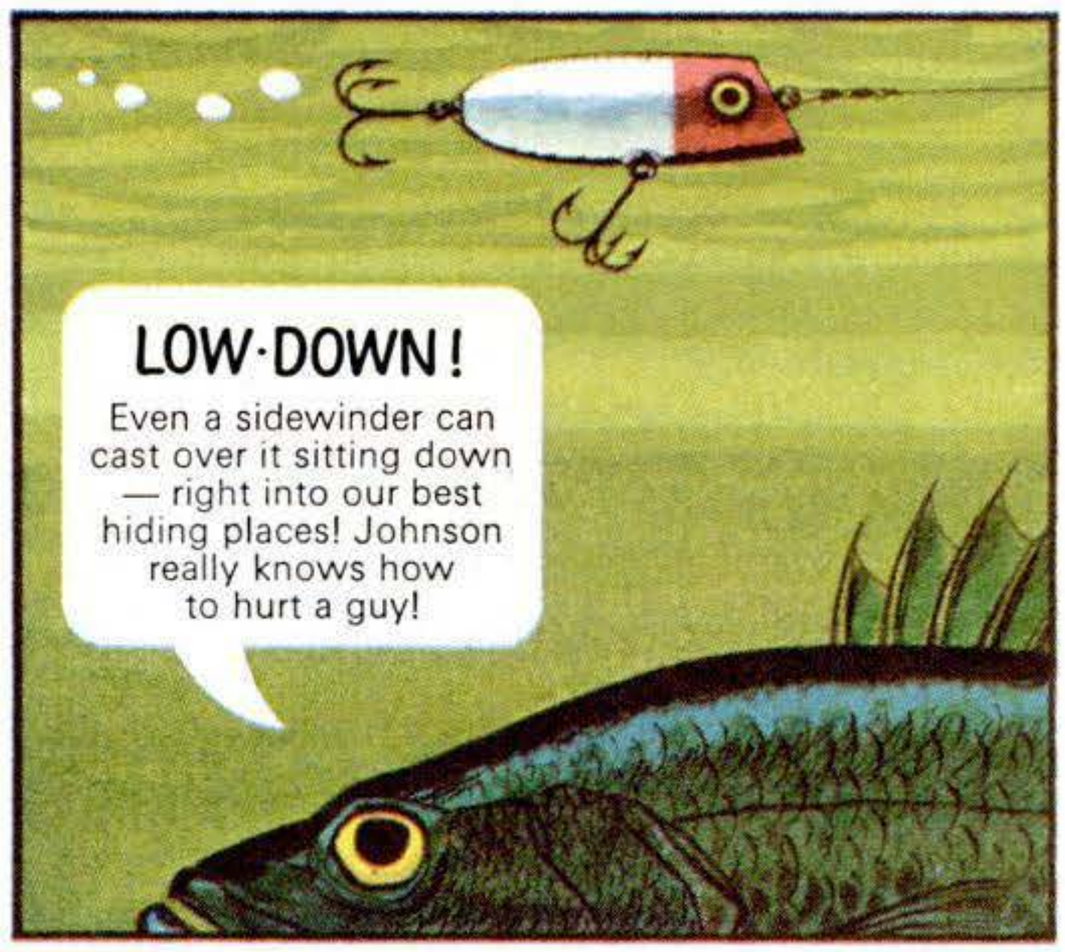
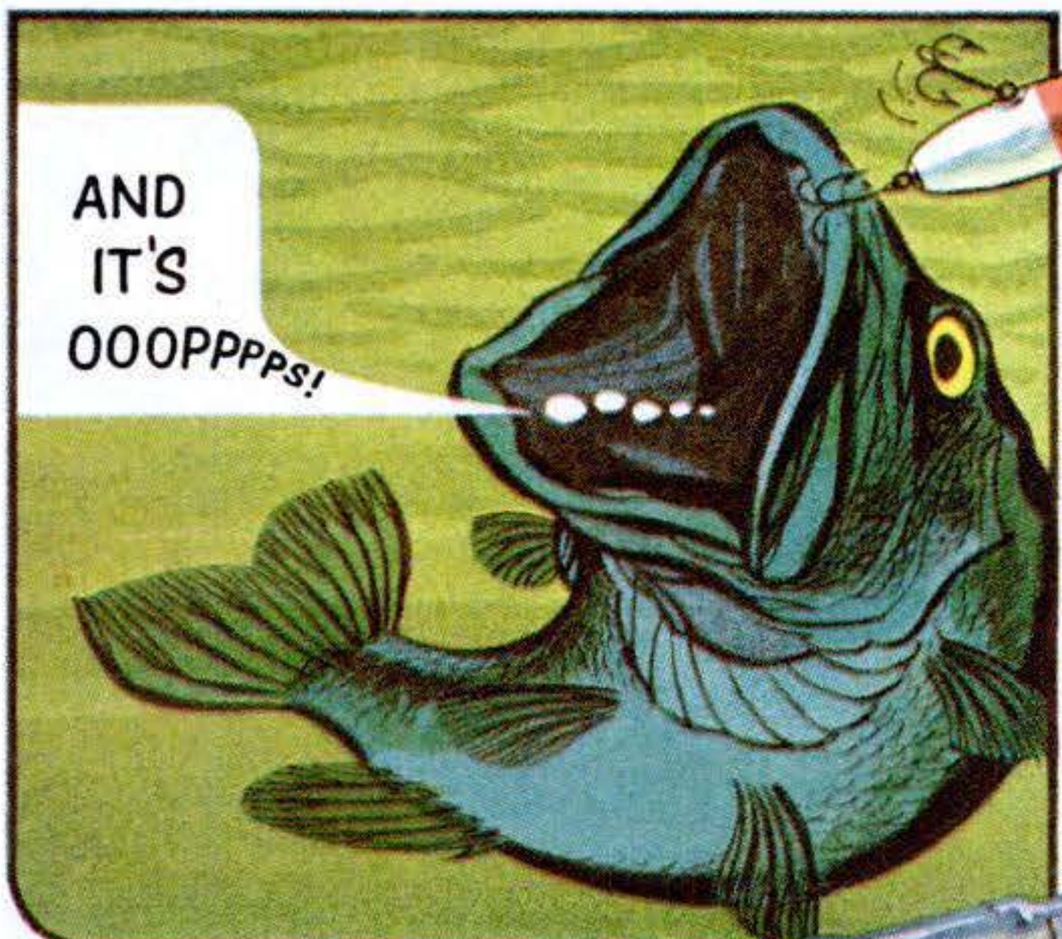
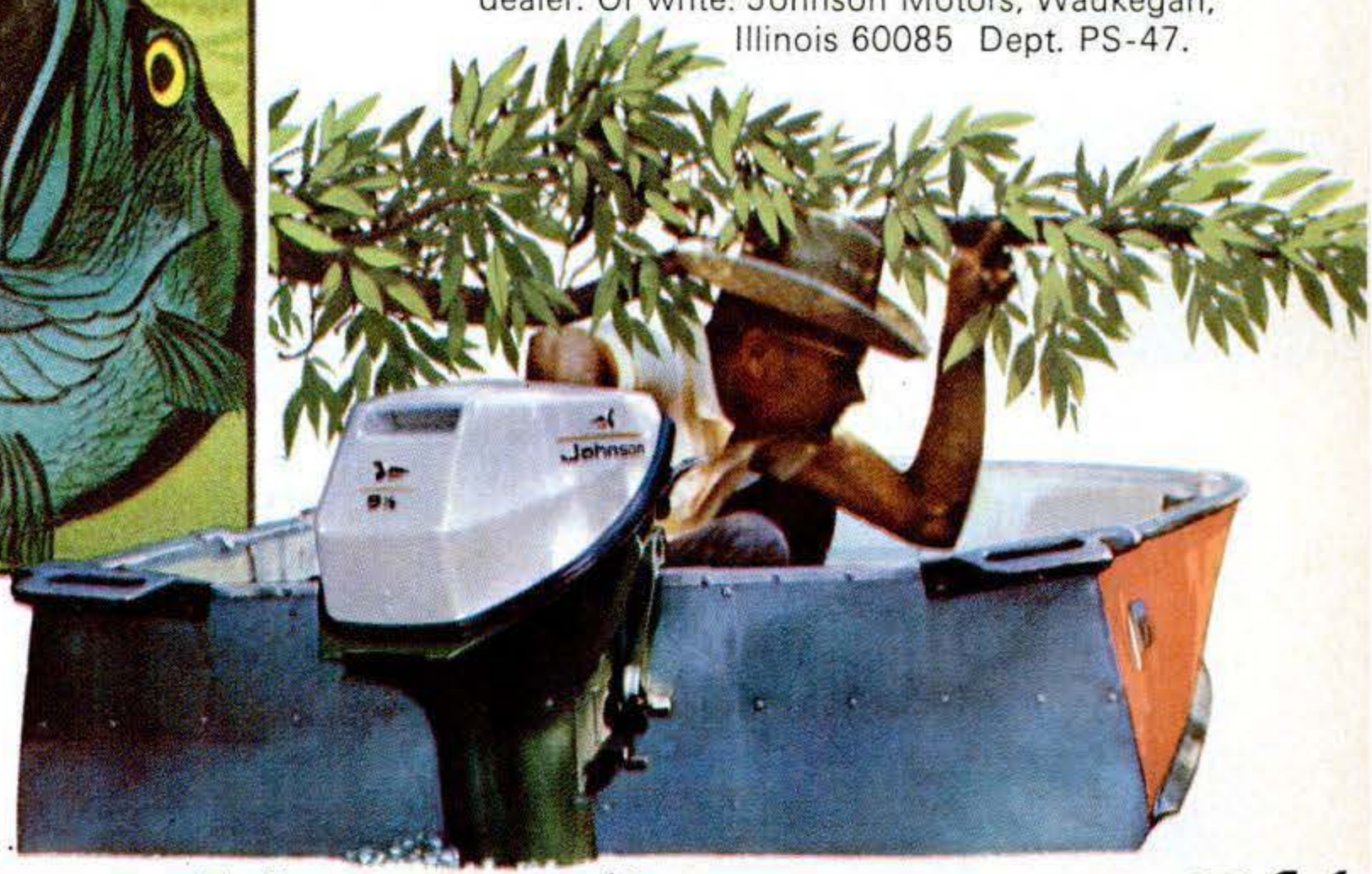






The "go get'em" design of our 9½ is improved with new vibration dampeners and fuel metering. Silky smooth even below 500 rpm, even in rough water. Easy stow, easy carry, too. For more motor lore, see the fisherman's friend, your Johnson dealer. Or write: Johnson Motors, Waukegan, Illinois 60085 Dept. PS-47.



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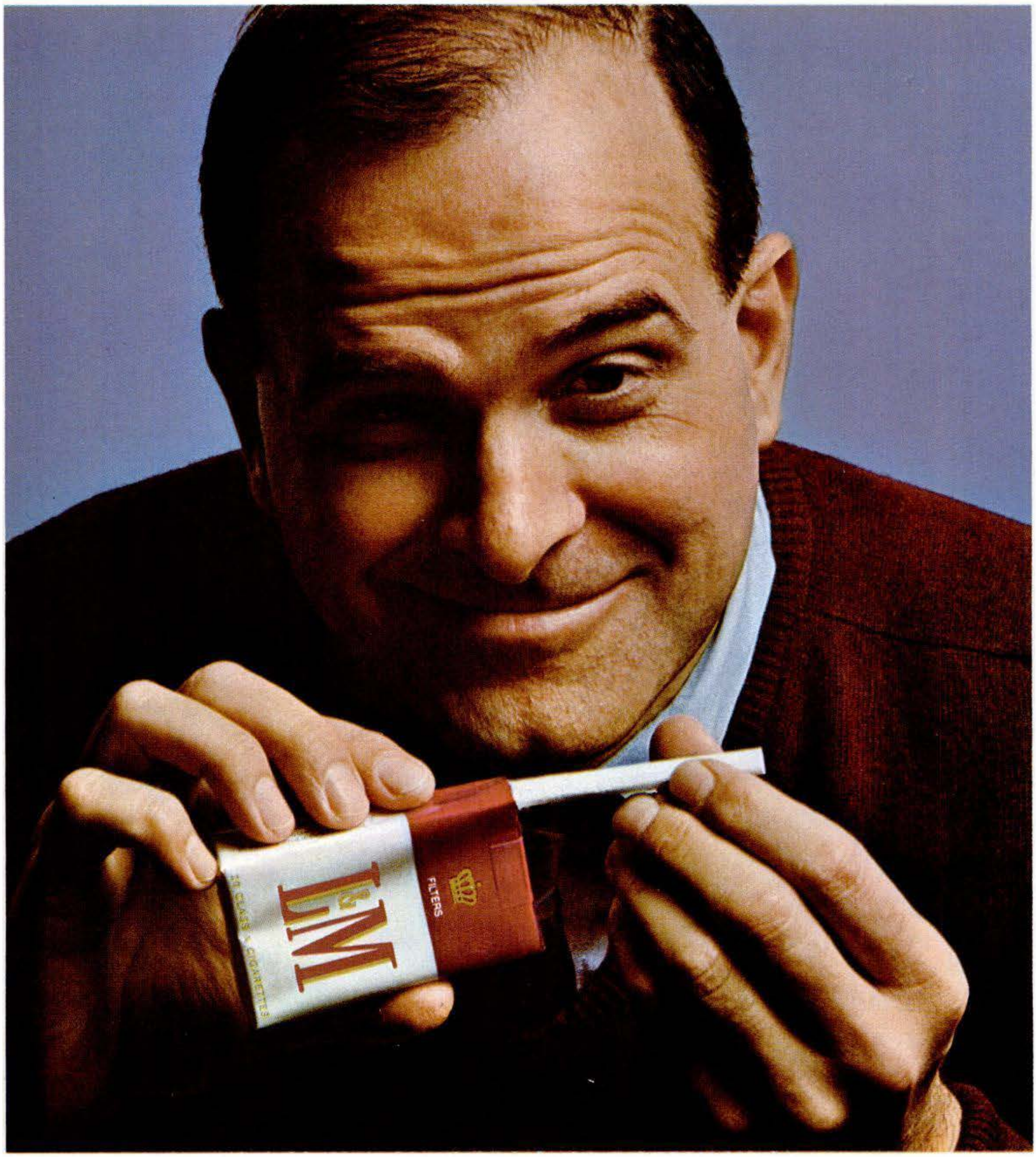

I, bold, brawny Bob Bevans, am a flavor grabber.

I never took a thing in my life. Before Petey Hansen joined my engineering crew, that is. You've seen Petey. Red hair. Freckles. Always smoking those L&M's.

So, last week, while he's out surveying, I grab one of his L&M's. Not bad! Not sharp. Not flat. But a good round flavor you don't get in any other filter cigarette.

Later, while Petey's busy, I grab another L&M. All of a sudden I'm a flavor grabber. Me, the chief engineer. So I run down to the corner and buy my own L&M's. I dig, when you grab hold of an L&M, you grab hold of flavor.

Now, will the guy on the crane who grabbed my L&M's please toss 'em back down!

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Popular Science
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Overall length of Toyo Kogyo's Cosmo is 163.6 inches. The car weighs only 2,020 pounds.

FIRST DRIVING REPORT: Japanese Wankel-Powered Car

Come for a test drive in the Cosmo— world's first twin-rotor RC-engined production car

By CARL GROTHMANN

This month, Japan puts into production the world's second assembly-line rotating combustion (RC) engine. Germany's NSU Motor Works already is turning out RC-powered cars.

A new sports car, the Cosmo, has been created especially for the Japanese RC engine, which will be produced by the Toyo Kogyo Co., of Hiroshima.

Like Curtiss-Wright's RC engine, Toyo Kogyo's has been developed from Felix Wankel's invention [PS, Apr. '66]. It has been aborning for six years. The engine is twin-rotored, like Curtiss-Wright's, and has a displacement of 60 cubic inches.

Production in the first few months will be limited to 200 cars a month.

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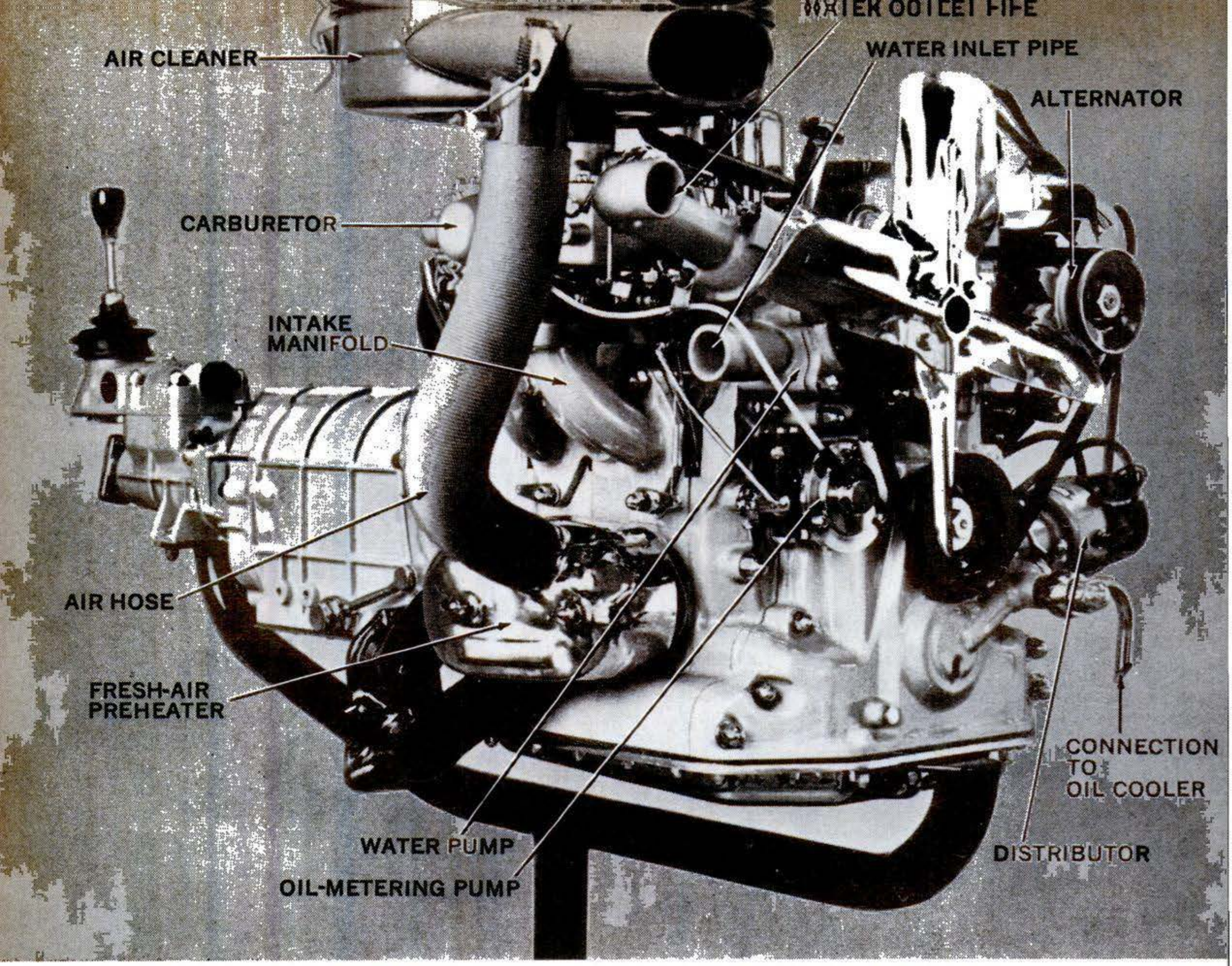

Cosmo engine weighs 225 pounds, runs on regular fuel with compression ratio of 8.6:1. Intake ports are lateral instead of peripheral, and each chamber has two plugs for more complete combustion.

Designed by Moriyuki Watanabe, the Cosmo has appealing lines, with traces of styling from U.S. Ford Thunderbirds of yesteryear. Like the original T-bird, the Cosmo is a two-seater, but much smaller and lighter.

The Cosmo—no toy. Only 47 inches high, the Cosmo looked to me, at first glance, like an oversized toy when I showed up to test-drive it. But that impression changed after I slipped behind the wheel.

The RC engine gets 110 hp. out of its 60 cubic inches. The Cosmo goes. Acceleration, particularly in the lower speeds, is sensational. A four-speed manual transmission takes it from 0-60 m.p.h. in 8.7 seconds and, in the passing range, from 25-70 m.p.h. in nine seconds flat. Top speed, 105 m.p.h., is somewhat less impressive, but for 60 cubic inches, it's not bad.

The transmission was designed for the engine, and it is well mated. A short-stemmed stick on the high hump between seats permits quick changes up or down.

Upshifts are recommended at 5,000 r.p.m. and the engine seems to grab hold of each gear as if it were waiting for it. A torque curve that is remarkably flat on top provides quick response to all demands.

From 65 pounds-feet at 1,000 r.p.m., torque climbs to 80 at 1,500 and 85 at 2,000. You get 92 at 3,000 r.p.m., 98 at 4,000, and 99 at 5,000. At 6,000 r.p.m., torque falls off only slightly, to 96 pounds-feet.

The Cosmo loafed along at 1,000 r.p.m. in top gear, without lugging, at a steady 12 m.p.h. When I jammed the accelerator down, it moved out quickly and without complaint. Acceleration was slower, of course, than when going through the gears but fast enough to make driving in traffic a delight for the laziest of drivers.

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The rotors reduce vibration to the point where it is only barely perceptible. This is true at idle, just over 800 r.p.m., as well as at 8,000 r.p.m.

But the engine is only slightly quieter than high-r.p.m. piston engines of similar power. Mostly it offers a *different* sound, particularly at high speed. In place of the clattering roar of the twin-cam Honda, the Cosmo gives off a humming growl at 8,000 r.p.m. From sound alone, you almost sense the engine is spinning instead of pounding up and down.

At idle, and up to 2,000 r.p.m., the RC engine does have a distinct advantage in noise level over piston engines.

At the wheel. The car handles with assurance, but the steering ratio of 16.6:1 is too quick for my taste. I felt it would take some time to get on familiar terms with that ratio, but very firm suspension helped to overcome some of my uneasiness. The suspension system, with coil springs and triangular control arms in front, leaf springs and a De Dion axle in the rear, makes for excellent roadholding.

A De Dion axle is a type of suspension with the wheel hubs connected by a tube, much like the dead U-beam rear axle on the front-drive Toronado. The drive shafts are open, and each has two universal joints. The shafts, in other words, are relieved of all locating duties and have only to transmit the drive to the wheels. The De Dion tube is free to move up and down with the wheels but is anchored to the chassis by radius rods, which keep it in proper fore-and-aft location under all conditions of load and thrust. The final-drive unit is bolted to the unit-construction body.

Braking, with disks up front and inboard drums in the rear, was straight and sure. I found no evidence of fade.

One of the biggest advantages RC engines have over their piston counterparts is low weight. A comparison with Toyo Kogyo's newest piston engine shows why.

For last fall's new piston-powered Luce, Toyo Kogyo developed a 91-cu.-in., four-cylinder, 290-pound engine that turns out 78 hp. at 5,500 r.p.m. The Cosmo's 60-cu.-in., RC engine turns out 32 more horsepower at 7,000 r.p.m. and weighs 65 pounds less. It is bigger than the single-rotor engine in NSU's Spider [PS, Jan. '65], but NSU has its own twin-rotor project [PS, Nov. '66].

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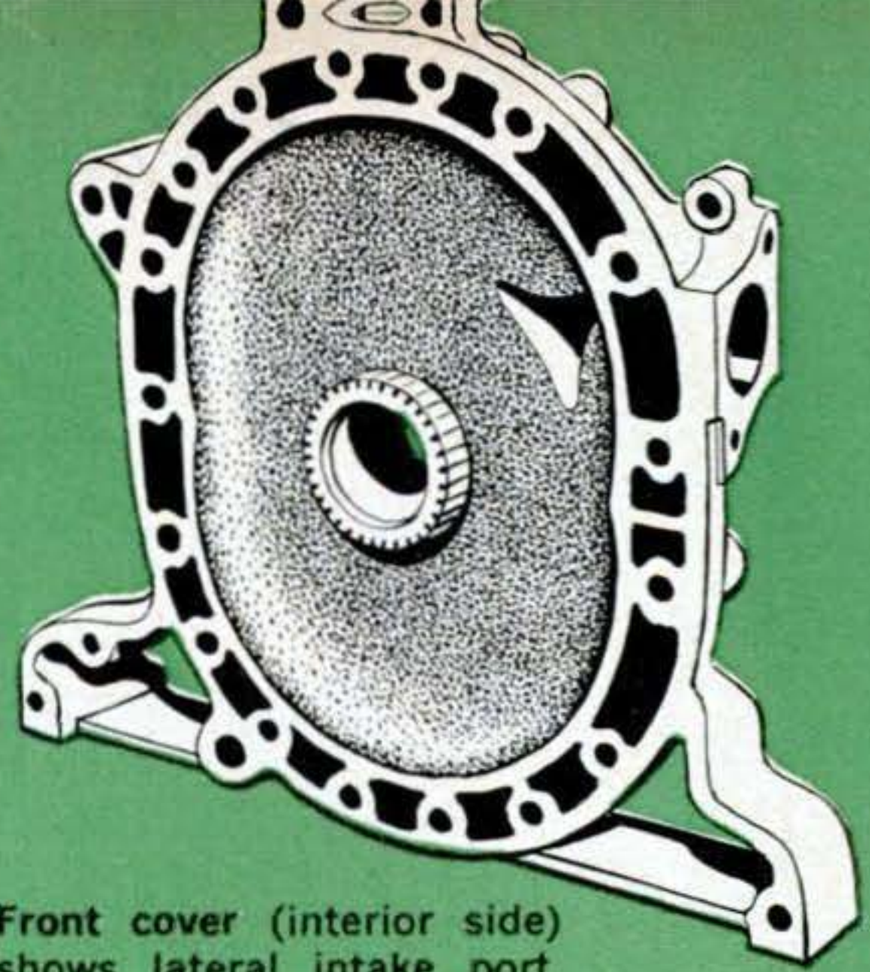
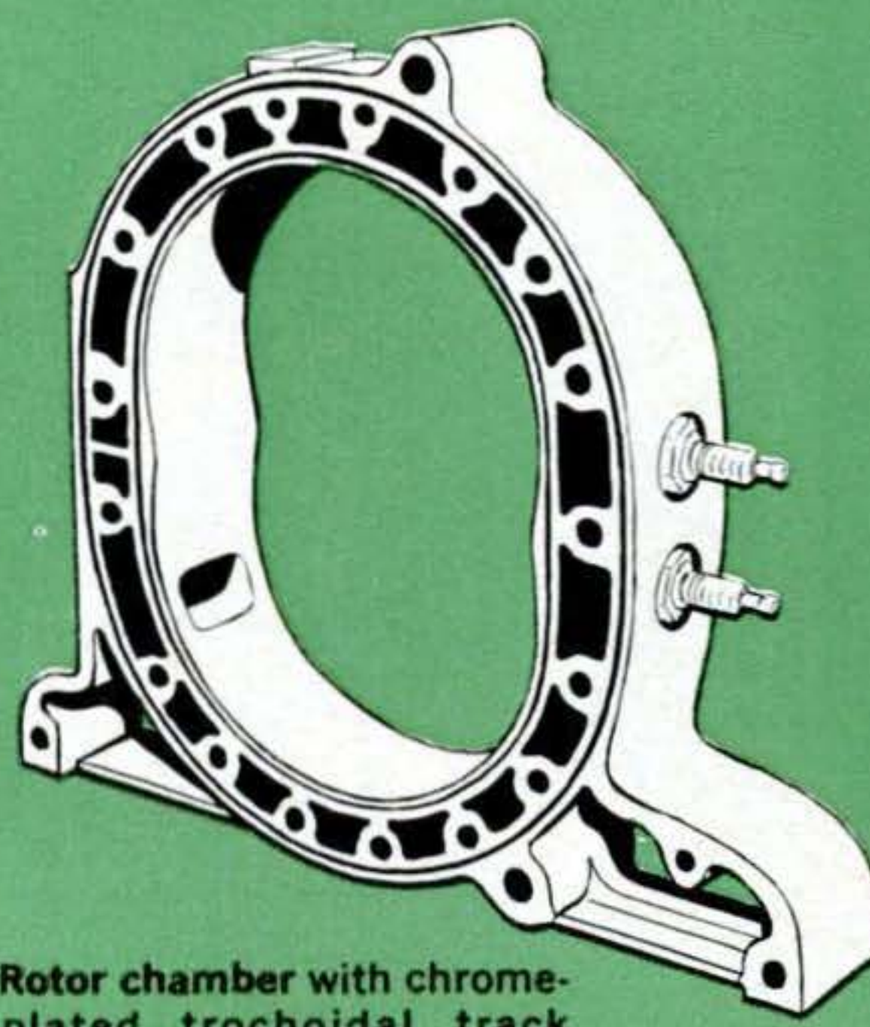
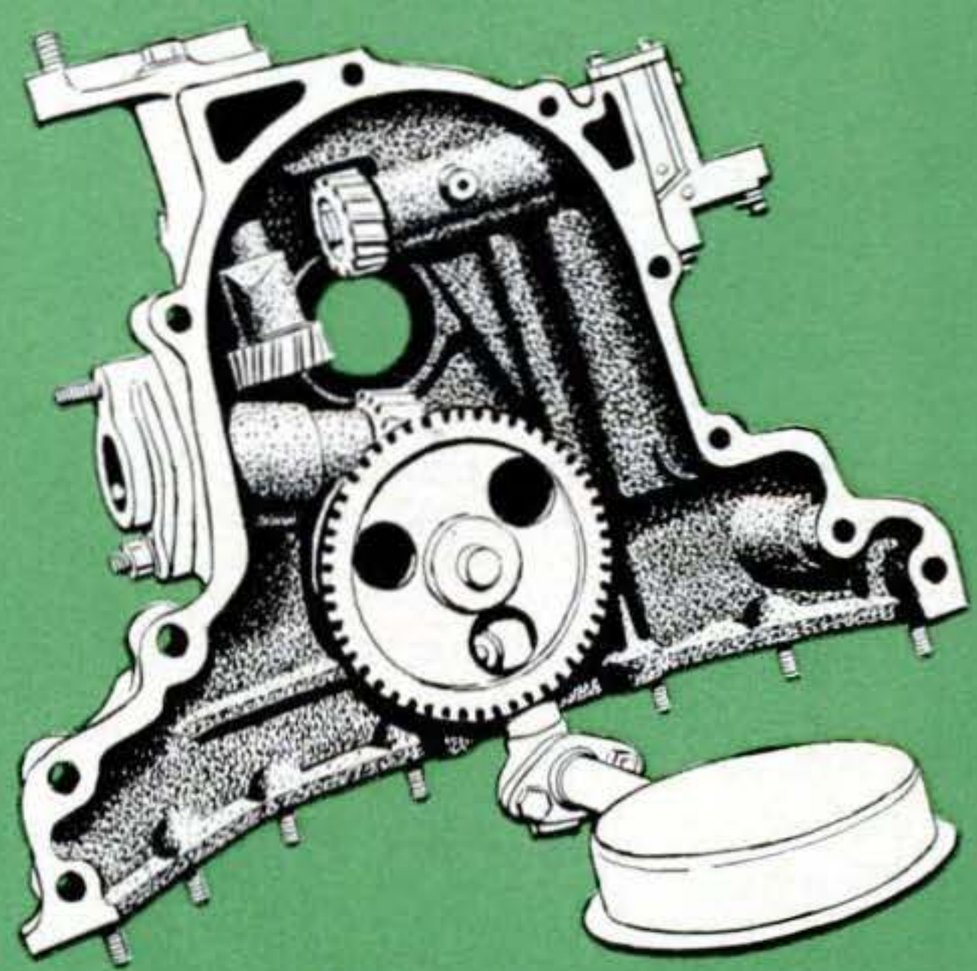


Front cover (interior side) shows lateral intake port, stationary reaction gear, water passages in housing.



Rotor chamber with chrome-plated trochoidal track shows peripheral exhaust port and dual spark plugs.



Accessory drives are in front extension. Gears drive distributor shaft, water-pump shaft, oil-pressure pump, oil-metering pump.

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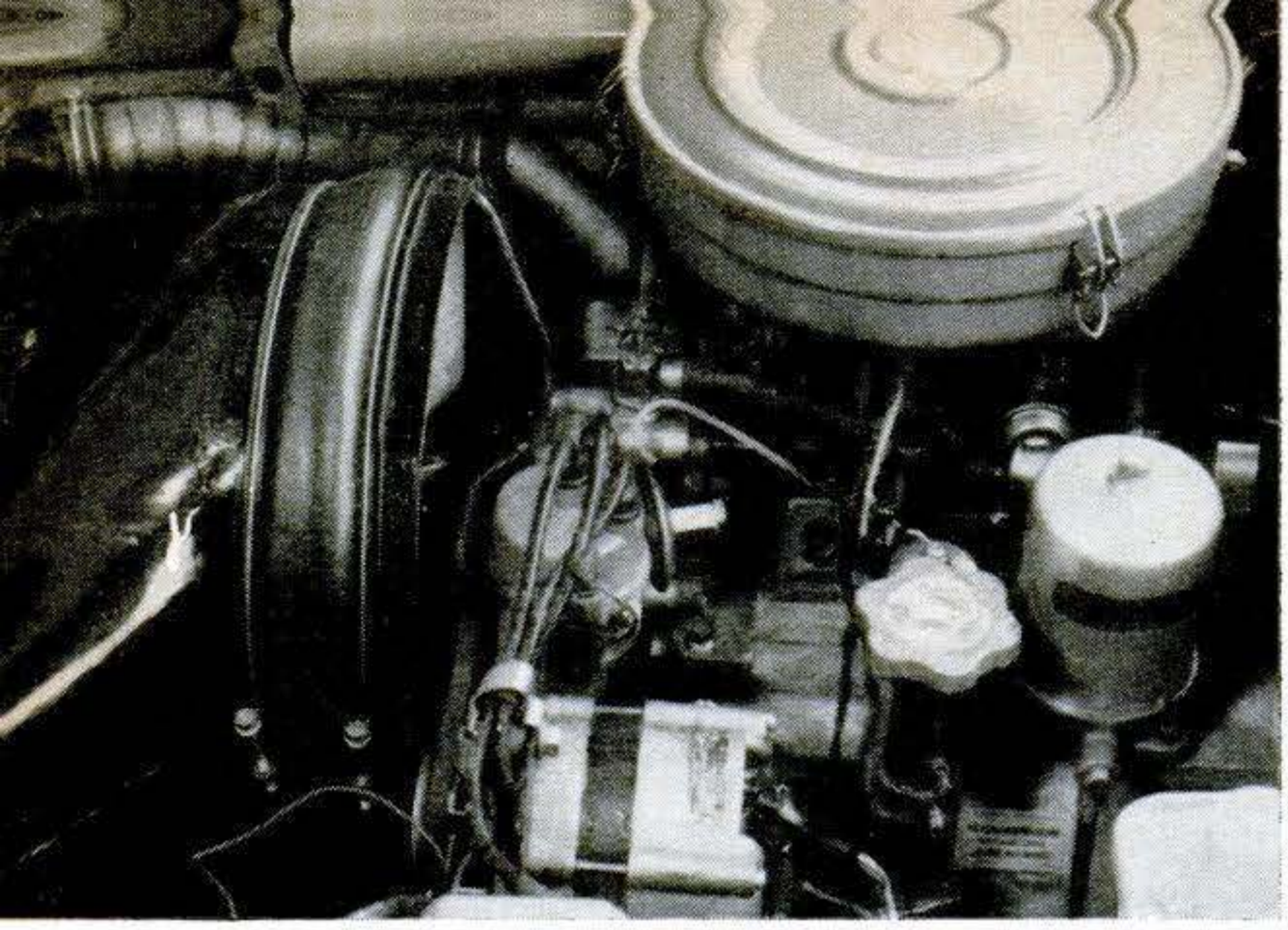
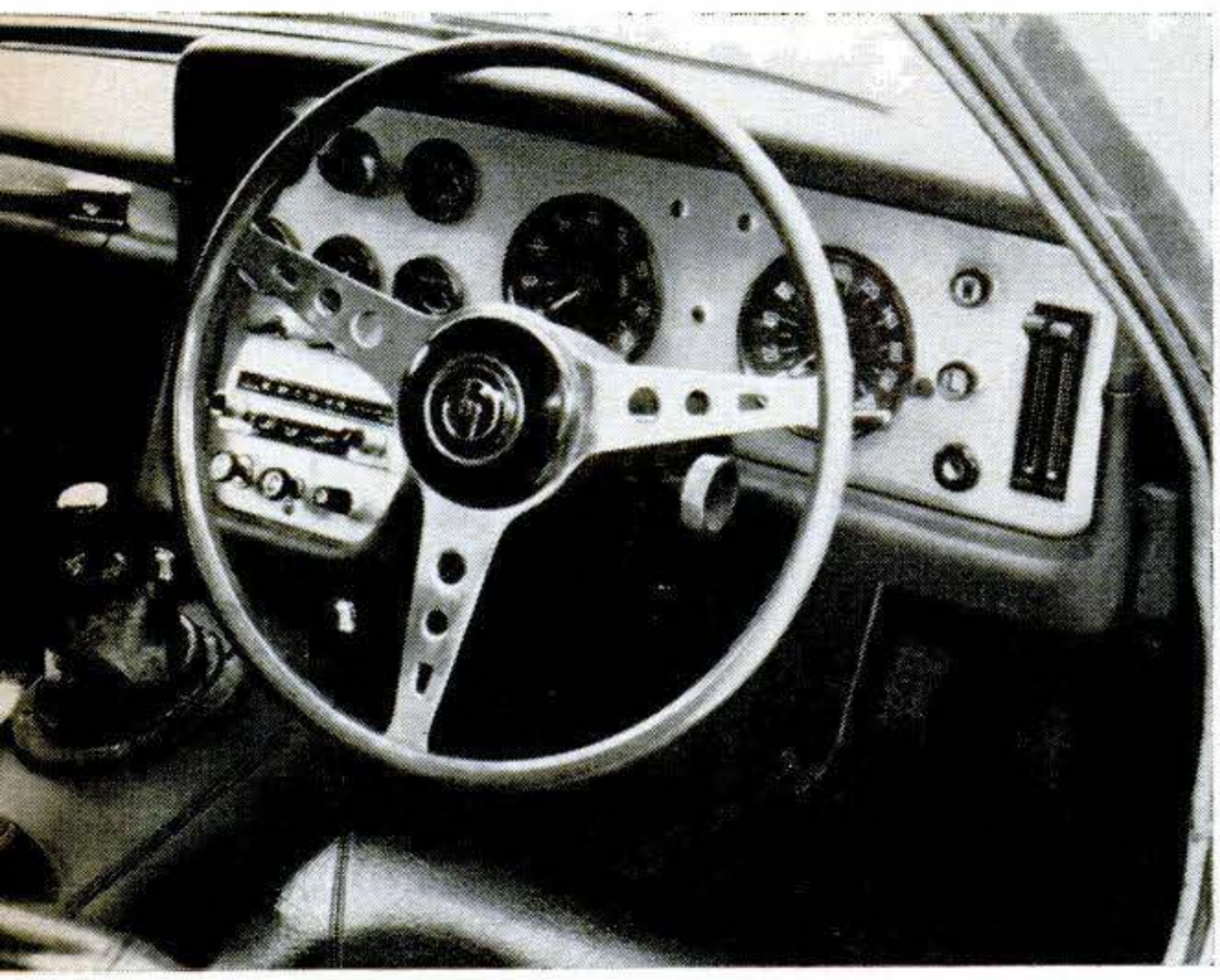


There's instant accessibility to the distributor, alternator, oil filler, and oil filter. Cooling fan is completely shrouded for greater effectiveness.



Cockpit is sensibly laid out and resembles other modern Japanese sports cars—Toyota, Daihatsu, Prince, and Datsun. Controls are conventional.

As in the Curtiss-Wright and the NSU RC engines [PS, Apr. '66], the Cosmo engine's power is supplied by rotors turning within a trochoidal (fat figure-eight) track of the engine housing. In Toyo Kogyo's aluminum engine, rotors of cast iron turn in a track that is chrome-plated to reduce wear. Just as pistons need rings to maintain compression, rotors need seals, and here Toyo Kogyo ran into a problem.

The rub. At 6,000 r.p.m., the apex seals of the Japanese engine slide along the trochoidal track at an average rubbing speed of 103 feet per second. The early seals wore out quickly. Then seals of a special carbon steel were developed. These are guaranteed for 100,000 kilometers (62,000 miles). Carbon is self-lubricating to a great extent, and, in a steel alloy, the brittleness of carbon can be overcome.

The side seals are subject to lower stress levels and are made of cast iron.

Lubrication oil for apex and side seals is supplied through the intake ports. Oil consumption is 1,200 miles per U.S. quart. As in the Curtiss-Wright engine, oil is also used to cool the rotor. The engine housing is water-cooled.

Guiding light behind Toyo Kogyo's RC engine is Kenichi Yamamoto, manager of the rotating-engine division. For six years he and a crew of 180 engineers and machinists worked on nothing else. But Yamamoto shares the credit with his computers.

"Without the computers," Yamamoto told me, "we would still be a few years away from production."

Toyo Kogyo's first RC engine was smaller (48 cu. in.) than the one in the Cosmo today. "It proved too small for the car we had in mind"—the Cosmo—said Yamamoto. "We increased displacement by 25 percent to get the engine we now have."

An experimental four-rotor RC engine is also under test in the Cosmo chassis.

Basic auto costs, expensive gasoline, and narrow roads all influence Japanese car design. More than half the passenger cars produced fall in the 22-62-cu.-in. range. In such a market the RC engine, with half the weight and size of a piston engine of similar power, is just the answer.

Toyo Kogyo has its own proving grounds, north of Hiroshima, built at a cost of more than $5 million. The company is especially proud of its high-speed oval, where cars can run up to 200 m.p.h. in relative safety. Perhaps one day a racing car using the RC engine will spring from this track.

The Cosmo will go on sale next month. Toyo Kogyo's licensing agreement with NSU has been amended to permit sales anywhere, including the U.S. The car's price is yet to be determined.

Next fall, they'll introduce a sedan powered by the same engine. Ultimately, Toyo Kogyo expects that all their vehicles will use RC engines, but change-over will be gradual, model by model. Today, Toyo Kogyo builds over 30,000 piston engines a month and the number grows each month. Nevertheless, Kenichi Yamamoto is convinced that "the RC engine is the automobile engine of the future—and the future isn't very far away." PS

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Rough-and-ready airborne jeep is off to a flying start

The Flying Jeep [PS, Dec. '64] is now undergoing rigorous precombat tests in the course of being readied for rugged jungle air-support missions. Accelerating for takeoff down a specially constructed rough field, North American's counterinsurgency plane, known officially as the OV-10A, dips its nose perilously close to a crack-up (top), but recovers and takes off (bottom) at 97 m.p.h. The test simulates conditions the plane will encounter in combat.

It's a Mod world on seesaw rocker

Two teen-agers find relaxing on this contour rocking chair lots of fun. The novel piece of furniture was designed by David Goodship and displayed recently at the Prototype Furniture Exhibition in London. The chair is made from three plywood pieces and cardboard tubes.

Mini-racer makes him a big wheel

Seven-year-old Tommy Barnard Jr. revs up his mini-racer powered by a lawn-mower motor, while his dad looks on. The elder Barnard, head of a British engineering firm, custom-built his son's car. Now he is offering the vehicle in a do-it-yourself kit for $420.

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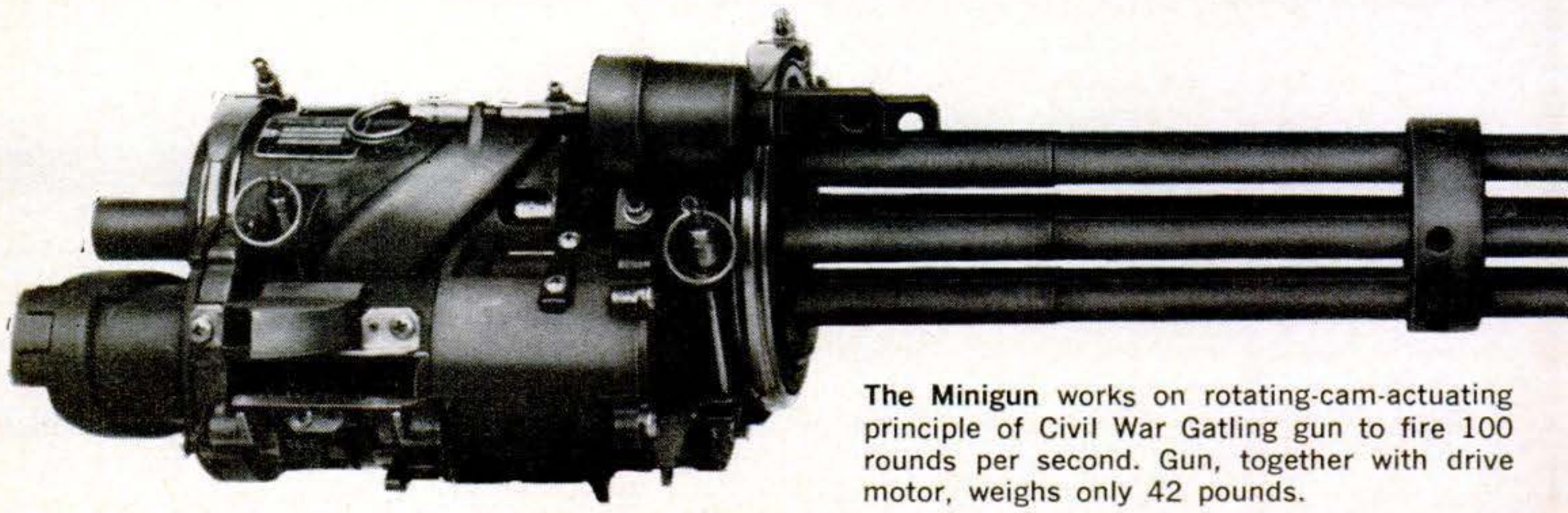
Puff, the Magic Dragon protects convoys from Vietcong attack. Gunners unleash 6,000 rounds per minute from each gun—enough to cover a football field in three seconds with one bullet per square foot.

PUFF, THE MAGIC DRAGON'S TEETH:

100-Bullet-a-Second Machine



The Minigun works on rotating-cam-actuating principle of Civil War Gatling gun to fire 100 rounds per second. Gun, together with drive motor, weighs only 42 pounds.

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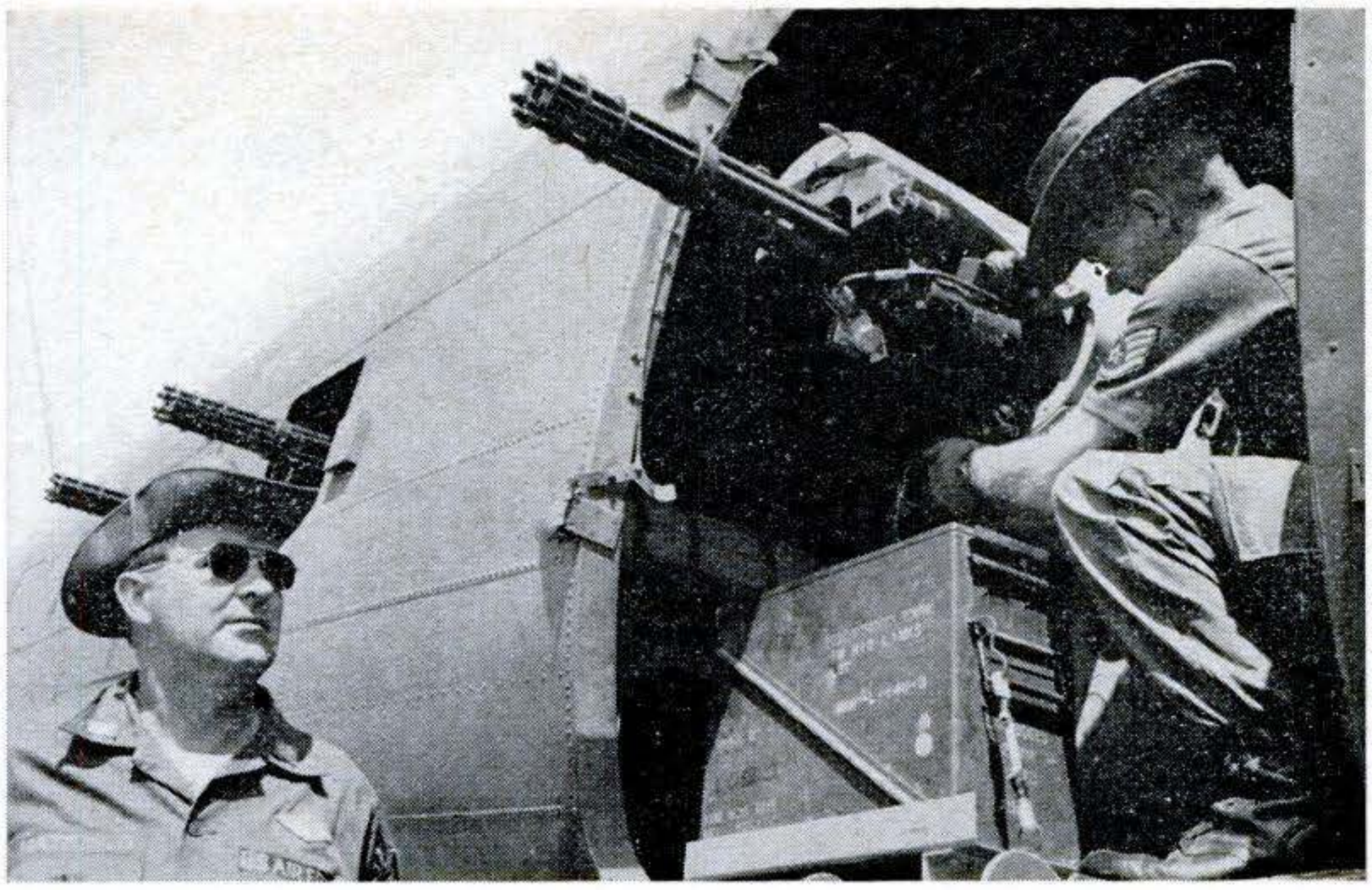
ILLUSTRATION BY BOB MCCALL



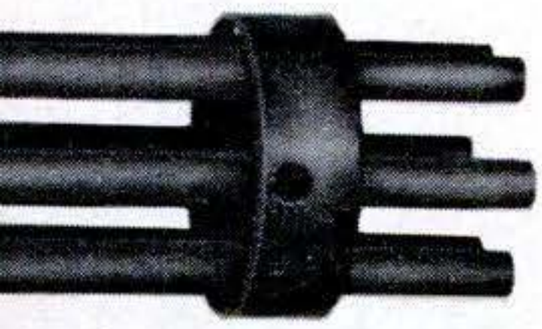
Three GE super-burp guns jut from port side of aged transport, military version of the DC-3, converted into attack cargo (AC) plane.

One of the most improbable weapons we've unleashed in the Vietnam war is an ancient cargo plane known as Puff, the Magic Dragon. Armed with the fastest firing gun ever used, these AC-47s (converted C-47s) have reportedly killed over 6,000 Vietcong in nearly two years with a loss of only one plane, shot down early this year.

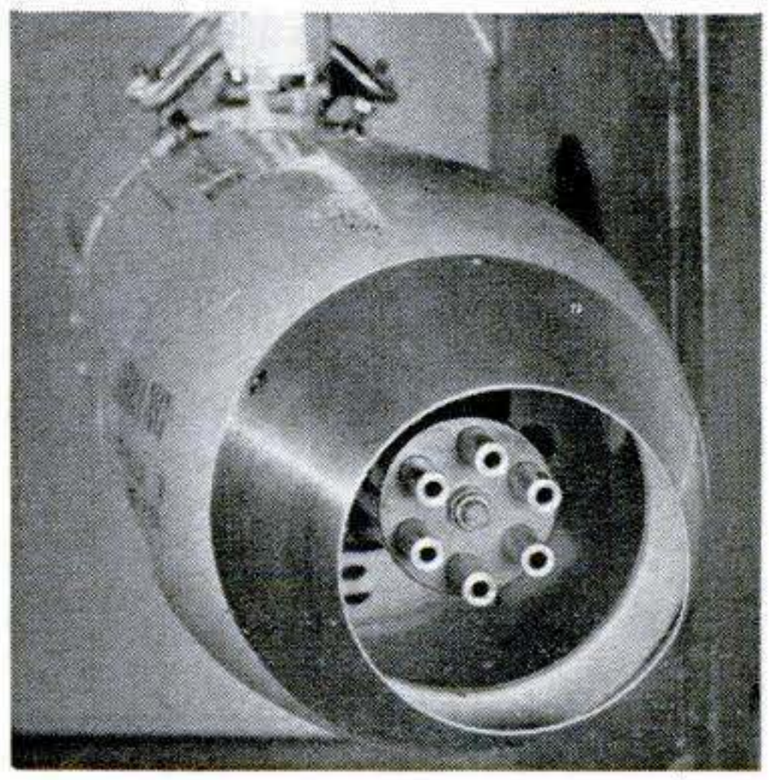
An unsung military genius turned the plane into a killer by punching three holes in the port side of one of these relics and tossing in three GAU-2B/A's—a super-burp gun that fires an unprecedented 6,000 shots per minute.

Made by General Electric, the six-barrel, 7.62mm-caliber (.30 inch) Minigun is the most revolutionary development in small-arms weaponry in 50 years. It gets its phenomenal rate of fire—100 rounds per second—from the externally powered rotating-cam-actuating principle of the old Civil War Gatling. The gun's six barrels are fastened to a spool-like "rotor" that revolves inside a stationary cylindrical "housing." A motor outside the housing drives the rotor. Each barrel has its own bolt. The six bolts ride in grooves on the rotor. Each bolt has an upright finger (cam follower) that rides in a groove (main cam) inside the housing. When the rotor-barrel cluster spins, the bolts reciprocate in their grooves as the finger follows the main cam.

Rotating *counterclockwise*, each of the six barrels feeds at five o'clock, fires at 12, and ejects at 6:30. One turn thus pumps out six shots, each barrel firing once. This cuts barrel heat and erosion, the limiting factors usually found in sustained fast firing.—*Jim Crane*.



Business end of pod shows six muzzles. The pods are self-contained and have been put on helicopters, attack fighters, and cargo planes.



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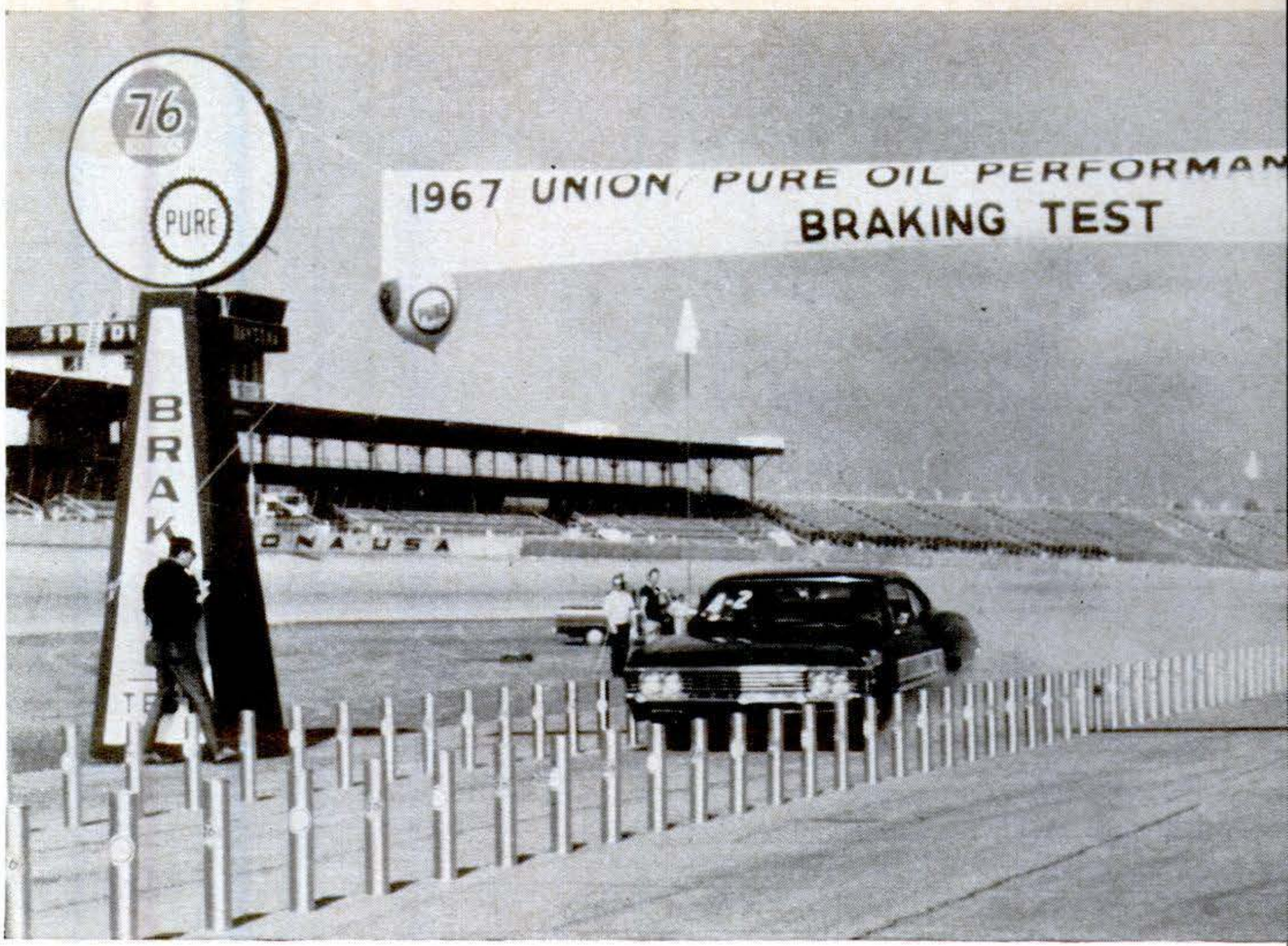

The World's Most

A record-breaking 86 entries turned out for this year's Union/Pure Oil Trials. Some of the results will surprise you

By **JAN P. NORBYE** / *PS Automotive Editor*

Of auto testing, there is no end. But most of it goes on behind the locked gates of the auto makers' proving grounds. And the results are kept as secret as a Chinese A-bomb test.

The Union/Pure Oil performance trials are different:

- They are publicly held, under strict NASCAR supervision.
- They are open to all domestic makes.
- The cars are drawn at random, by NASCAR, from dealers' showrooms.
- Test conditions are the same for all.
- The results are wide open to you.

That's why we call them "the world's most revealing car tests." To see how the '67 cars stack up, look at the table on a following page. You'll find a lot of surprises.

Breaking old records. This year, more cars were entered than ever before.

The record for fuel economy at a steady 40 m.p.h. went up from 25.003 m.p.g. (Corvair) to 26.045 (Corvair).

The record for 25-70-m.p.h. acceleration

Showing the best brake performance in the Super Deluxe class, Len Rulason—last year's Gold Cup winner—stopped this Buick Electra in 191.5 feet.

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James Musser, assistant chief engineer of Chevrolet, accepts the POPULAR SCIENCE Gold Cup award for shortest stopping distance from Hubert Luckett, Executive Editor. Left, Bill Horton stops Impala in 166.8 feet.

Revealing Car Tests

went from 6.545 seconds (Chevelle SS 396) to 5.585 (Ford Fairlane GT).

But no records were broken in the brake tests. Does this mean that brakes are getting worse instead of better? Judge for yourself from the figures: Average stopping distance from 65 m.p.h. went up from 191.05 feet in '66 to 199.94 feet in '67. (That's not counting penalties for swerving under braking and knocking down lane markers—two feet for each spilled marker.)

Remember, this brake test is devised to show you how well a car would serve you if you had to make an emergency stop after hard use of the brakes, for instance on a crowded expressway or a curvy mountain road. Each car makes 10 easy warm-up stops from high speed. This insures that heat build-up is in the brake system rather than in the tires. Finally, there's a spec-

Continued

Winner in Deluxe V-8 class, Olds Delmont 88 driven by Tom Blankenship also had best brakes in its class. It stopped from 65 m.p.h. in 179.4 feet.

Dick Haas slides Olds Delmont 88 to a full stop in 173.4 feet from 65 m.p.h. to place best on brake performance in class for Medium V-8-powered cars.

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Best stop in Intermediate V-8 class—172.1 feet—was made by Buddy Baker, who stepped so hard on brake pedal in this Belvedere that bracket was bent.

Ford's Johnny Allen forced slightly weaving Fairlane to a full stop in 170.7 feet for best brake performance among Intermediate six-cylinder cars.

Les Viland's Rambler American 220 came out best on total points in Compact six-cylinder class; posted shortest braking distance in class: 170.0 feet.

Stock-car racer Buddy Baker worked hard to keep Plymouth GTX inside braking test lane, but won Sports Intermediate class with stop in 183.4 feet.

Ford Mustang, Billy Cox at wheel, showed shortest braking distance in Sport Compact class with a stop in 175.5 feet, narrowly beating two Camaros.

tacular panic stop as the driver slams on the brakes and skids to full stop from at least 65 m.p.h. in an 11-foot-wide lane.

Fewer cars stopped in a reasonable distance this year. In the '66 trials, 76.3 percent stopped in less than 200 feet; only 62.6 percent in '67. Last year, 20.3 percent stopped within 10 feet of the measurement of the car with the shortest braking distance; this year, only 13.2 percent.

Cars were less controllable under braking. Last year, eight cars knocked down 118 markers; this year, 19 cars knocked down 544. A year ago, 86.3 percent of the cars stayed in lane; in '67 only 75 percent.

There's no progress in minimum braking distances. This year's Gold Cup winner, a Chevrolet Impala, stopped in 166.8 feet. That's 1.4 feet less than last year's winner (Buick Special), but fully five feet more than the '65 winner (Pontiac Le Mans). In '65, there was also a Buick Wildcat that stopped in 164.8 feet.

Chevrolet brakes have improved—last year's Caprice took 180.8 feet to stop. But can you figure out why Buicks and Pontiacs can't approach past performance?

Disk brakes. Disks were a big disappointment in these trials. Four cars had disk brakes. Two—Thunderbirds—went straight, but took horrendous distances to stop (see table). Of two Mercury S-55s, one was almost up to average, but the other slithered sideways and knocked down 42 markers.

This doesn't shake my faith in disk brakes. (I stopped a disk-braked Polara in 153½ feet from 60 m.p.h. [PS, Jan.] without even locking the wheels.) They work on a superior principle. But apparently Ford's brake engineers have not found the right combination of lining material, disk size, friction area, and cooling provision for these heavy cars.

What happened to the Pontiacs? NASCAR officials found mechanical alterations in the fuel system and disqualified all but one. The Chrysler (marked DNF in table) that did not finish the brake test didn't run out of brakes—the throttle linkage broke.

In the past, I've noted that a car that scores top points in acceleration usually doesn't do too well in economy, and vice versa. But this year the Toronado came out best in its class in both categories. Also, a Ford Custom proved fastest as well as leanest on gas among the standard V-8s. PS

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How They Scored

		ENGINE TYPE	CUBIC INCHES	HORSEPOWER	AXLE RATIO	WHEELBASE (in.)	ECONOMY: MILES PER GALLON	ECONOMY: POINTS	ACCELERATION: TIME (sec.)	ACCELERATION: POINTS	BRAKING: STOPPING DISTANCE (ft.)	BRAKING: POINTS	TOTAL POINTS
CLASS I SUPER DELUXE	Buick Electra 225	V-8	430	360	2.78	126	15.865	7	8.255	9	191.5	10	26
	Buick Riviera	V-8	430	360	3.07	119	15.445	6	8.560	8	195.4	9	23
	Chrysler New Yorker	V-8	440	350	2.76	124	14.416	4	8.685	7	383.8	4	15
	Oldsmobile 98	V-8	425	365	3.08	126	16.752	9	9.640	4	282.7	6	19
	Oldsmobile Toronado	V-8	425	385	3.21	119	17.300	10	7.890	10	222.2	8	28
	Thunderbird Landau 4-Door	V-8	390	315	3.00	117	14.689	5	9.500	5	283.9	5	15
	Thunderbird Landau 4-Door	V-8	390	315	3.00	117	16.073	8	9.180	6	240.3	7	21
CLASS II DELUXE 8-CYLINDER	Buick Wildcat	V-8	430	360	3.07	126	15.758	5	8.445	8	192.7	8	21
	Buick Wildcat	V-8	430	360	3.07	126	15.782	6	9.070	6	188.3	9	21
	Chrysler 300	V-8	440	350	2.76	124	14.231	3	8.925	7	261.6	5	15
	Dodge Monaco 500	V-8	383	325	2.76	122	15.084	4	10.600	3	265.5	4	11
	Mercury S 55	V-8	428	345	2.80	123	17.146	8	7.725	10	303.4	3	21
	Mercury S 55	V-8	428	345	2.80	123	16.885	7	7.855	9	217.0	7	23
	Oldsmobile Delmont 88	V-8	425	310	2.93	123	17.466	10	9.875	4	179.4	10	24
	Oldsmobile Delmont 88	V-8	425	310	2.93	123	17.435	9	9.710	5	239.9	6	20
CLASS III MEDIUM 8-CYLINDER	Buick LeSabre	V-8	340	220	2.93	123	13.985	3	12.705	3	185.7	7	13
	Buick LeSabre	V-8	340	220	2.93	123	13.268	2	12.845	2	190.0	5	9
	Chrysler Newport	V-8	383	270	2.76	124	15.980	5	11.480	4	DNF	—	9
	Dodge Polara 500	V-8	383	270	2.76	122	15.380	4	11.325	5	308.2	3	12
	Mercury Monterey	V-8	390	270	2.75	123	17.130	8	9.855	10	182.9	8	26 + 5
	Mercury Monterey	V-8	390	270	2.75	123	16.617	6	10.525	9	220.7	4	19
	Oldsmobile Delmont 88	V-8	330	260	2.78	123	18.609	9	11.020	8	182.6	9	26 + 5
	Oldsmobile Delmont 88	V-8	330	260	2.78	123	18.616	10	11.165	6	173.4	10	26 + 6
	Pontiac Catalina	V-8	400	290	2.41	121	16.672	7	11.055	7	188.3	6	20
CLASS IV STANDARD 8-CYLINDER	Chevrolet Biscayne	V-8	283	195	3.08	119	18.844	9	14.425	5	183.3	6	20
	Chevrolet Impala	V-8	283	195	3.36	119	17.217	7	12.870	7	166.8	10	24
	Ford Galaxie 500	V-8	289	200	2.80	119	18.271	8	13.595	6	179.1	8	22
	Ford Custom	V-8	289	200	2.80	119	20.125	10	12.030	10	177.0	9	29
	Plymouth Fury III	V-8	318	230	2.94	119	16.000	6	12.270	9	223.7	5	20
	Ambassador DPL	V-8	290	200	3.15	118	15.970	5	12.525	8	182.7	7	20
CLASS V INTERMEDIATE 8-CYLINDER	Buick Skylark	V-8	340	220	2.78	115	18.040	3	10.505	7	203.6	5	15
	Buick Skylark	V-8	340	220	2.78	115	18.330	4	11.395	3	182.9	8	15
	Dodge Charger	V-8	318	230	2.94	117	16.228	0	11.865	2	219.4	2	4
	Ford Fairlane 500	V-8	289	200	2.80	116	19.800	8	10.705	4	183.2	7	19
	Ford Fairlane 500	V-8	289	200	2.80	116	19.803	9	10.630	5	203.0	6	20
	Mercury Capri	V-8	289	200	2.80	116	19.890	10	10.400	8	219.1	3	21
	Mercury Capri	V-8	289	200	2.80	116	19.780	7	10.575	6	239.4	1	14
	Oldsmobile Cutlass Supreme	V-8	330	320	3.08	115	18.362	5	8.145	10	178.1	9	24
	Oldsmobile Cutlass Supreme	V-8	330	320	3.08	115	16.725	1	8.740	9	210.7	4	14
	Plymouth Belvedere II	V-8	273	180	2.94	116	18.642	6	14.470	0	172.1	10	16
	Rambler Rebel SST	V-8	290	200	3.15	114	17.376	2	12.230	1	310.9	0	3
CLASS VI INTERMEDIATE 6-CYLINDER	Buick Special	V-6	225	160	2.93	115	21.344	4	14.625	8	214.0	2	14
	Buick Special	V-6	225	160	2.93	115	21.247	3	13.840	10	186.3	3	16
	Dodge Coronet	OHV-6	225	145	2.93	117	20.105	1	19.620	1	182.8	4	6
	Ford Fairlane	OHV-6	200	120	2.80	116	23.762	10	17.680	5	170.7	10	25
	Ford Fairlane	OHV-6	200	120	2.80	116	22.146	7	19.335	2	216.6	1	10
	Mercury Comet 202	OHV-6	200	120	2.80	116	22.297	8	18.600	3	179.5	6	17
	Mercury Comet 202	OHV-6	200	120	2.80	116	23.265	9	17.790	4	181.1	5	18
	Oldsmobile F 85	OHV-6	250	155	2.78	115	21.427	5	15.200	7	177.5	7	19
	Oldsmobile F 85	OHV-6	250	155	2.78	115	21.454	6	14.000	9	175.3	8	23
	Plymouth Belvedere I	OHV-6	225	145	2.93	116	20.248	2	16.480	6	174.4	9	17
CLASS VII COMPACT 6-CYLINDER	Chevy II 100	OHV-6	194	120	3.08	110	22.481	4	19.315	7	175.4	7	18
	Chevrolet Corvair 500	H-6	164	95	3.27	108	26.045	10	20.825	4	172.4	9	23
	Dodge Dart	OHV-6	170	115	2.76	111	25.385	9	18.685	8	173.0	8	25
	Falcon	OHV-6	170	105	2.83	111	23.980	5	19.695	6	179.3	6	17
	Falcon Futura	OHV-6	200	120	2.83	111	24.323	6	16.565	9	191.1	4	19
	Plymouth Valiant 100	OHV-6	170	115	2.76	108	24.403	7	20.415	5	179.7	5	17
	Rambler American 220	OHV-6	199	128	2.73	106	24.738	8	16.145	10	170.0	10	28
CLASS VIII SPORT INTERMEDIATE	Buick GS 400	V-8	400	340	2.93	115	18.406	7	6.775	0	187.4	9	16
	Buick GS 400	V-8	400	340	2.93	115	17.920	6	6.560	2	193.9	7	15
	Chevelle SS 396	V-8	396	325	2.73	115	18.790	10	6.695	0	199.2	6	16
	Chevelle SS 396	V-8	396	325	2.73	115	18.556	9	6.305	3	258.6	0	12
	Dodge RT	V-8	440	375	2.94	117	14.144	0	5.895	8	192.4	8	16
	Ford Fairlane GT	V-8	390	320	3.25	116	17.158	5	6.085	4	206.4	4	13
	Ford Fairlane GT	V-8	390	320	3.25	116	17.070	4	5.585	10	247.8	1	15
	Mercury Cyclone GT	V-8	390	320	3.25	116	15.703	1	6.075	5	205.0	5	11
	Mercury Cyclone GT	V-8	390	320	3.25	116	16.613	2	6.015	6.5	219.6	3	11.5
	Oldsmobile 4-4-2	V-8	400	350	3.23	115	18.552	8	5.760	9	234.0	2	19
	Oldsmobile 4-4-2	V-8	400	350	3.55	115	16.919	3	6.015	6.5	250.2	0	9.5
	Plymouth GTX	V-8	440	375	2.94	116	15.528	0	6.690	1	183.4	10	11
CLASS IX SPORT COMPACT	Chevrolet Camaro	V-8	327	210	3.08	108	20.511	7	8.615	10	179.8	8	25
	Chevrolet Camaro	V-8	327	210	3.08	108	19.744	5	9.000	9	177.6	9	23
	Dodge Dart GT	V-8	273	180	3.23	111	20.389	6	10.145	5	255.8	4	15
	Ford Mustang 2 + 2	V-8	289	200	2.79	108	23.895	10	9.195	7	182.2	7	24
	Ford Mustang 2 + 2	V-8	289	200	2.79	108	22.297	9	9.145	8	175.5	10	27
	Plymouth Barracuda	V-8	273	180	2.93	108	20.753	8	11.315	4	186.1	6	18
	Rambler American Rogue	V-8	290	200	3.15	106	19.579	4	9.420	6	189.6	5	15

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Are you wasting money on WORTHLESS HEALTH AIDS?

By JAMES C. G. CONNIFF

Are Americans throwing away a fortune on health gimmicks when they'd be better off putting the money into good food? Dr. James Lee Goddard, the new U.S. Food and Drug Commissioner, says we're doing just that. And how about such things as cold remedies, nerve tonics, diet aids, and other nostrums? Are they always all they're cracked up to be? Recent FDA actions tell the story: They're not.

Dr. Goddard, himself a physician, says if you're eating "a normal variety of food and have no special medical problems," you don't need vitamins or any other dietary supplement. People who gulp a daily vitamin pill or choke down brewer's yeast, he says, are needlessly, wastefully shoveling money into a $350-million sucker trap.

The actual take, Goddard believes, "might well be higher." His lean jaw juts in controlled anger at the thought. "The public," he fumes, "has been deluded. The consumer has been cheated."

What's Being Done to Protect You?

Harsh words from a top government official? Maybe—but they're only a sample. Dr. Goddard believes the Food and Drug Administration has a duty, under mandate of the Congress, "to protect the consumer from economic as well as medical frauds." He therefore does not hesitate in proposing and enforcing stiff regulations for so-called health aids.

"Essentially," he says, "we want to give the consumer more *facts* about health aids. If a product is promoted for its value in weight reduction, we believe the label should tell the buyer just how many calories he is saving. And low-calorie claims would not be permitted when that saving is insignificant. There is also a need for definite standards for vitamin and mineral pills, and for fortified foods."

The chief weapon that the Food and Drug Administration is using against phony health aids is a set of new regulations designed to protect consumers, which will go into effect shortly. Goddard hopes they will "sweep away many common misconceptions about the kinds and amounts of vitamins and minerals needed in the diet, and how they can be obtained."

No "Minimum Daily Requirement"

"Most Americans eat foods that provide all the vitamins and minerals normally required for good health," Dr. Goddard maintains. "The term 'minimum daily requirement' for vitamins and minerals has been widely misunderstood and frequently misrepresented. If 30 milligrams of vitamin C is the 'minimum daily requirement,' many people think 60 milligrams must be twice as beneficial. In fact, the body cannot use excessive quantities of vitamins and minerals, and eliminates most superfluous amounts. The 'minimum daily requirement' is neither a 'minimum' nor a 'requirement.' "

What scientific authority backs up the new FDA regulations on special diet foods and dietary supplements? Dr. Goddard says that in drawing them up, "our own nutrition specialists adapted the Recommended Dietary Allowances established by the Food and Nutrition Board of the National Academy of Sciences-National Re-

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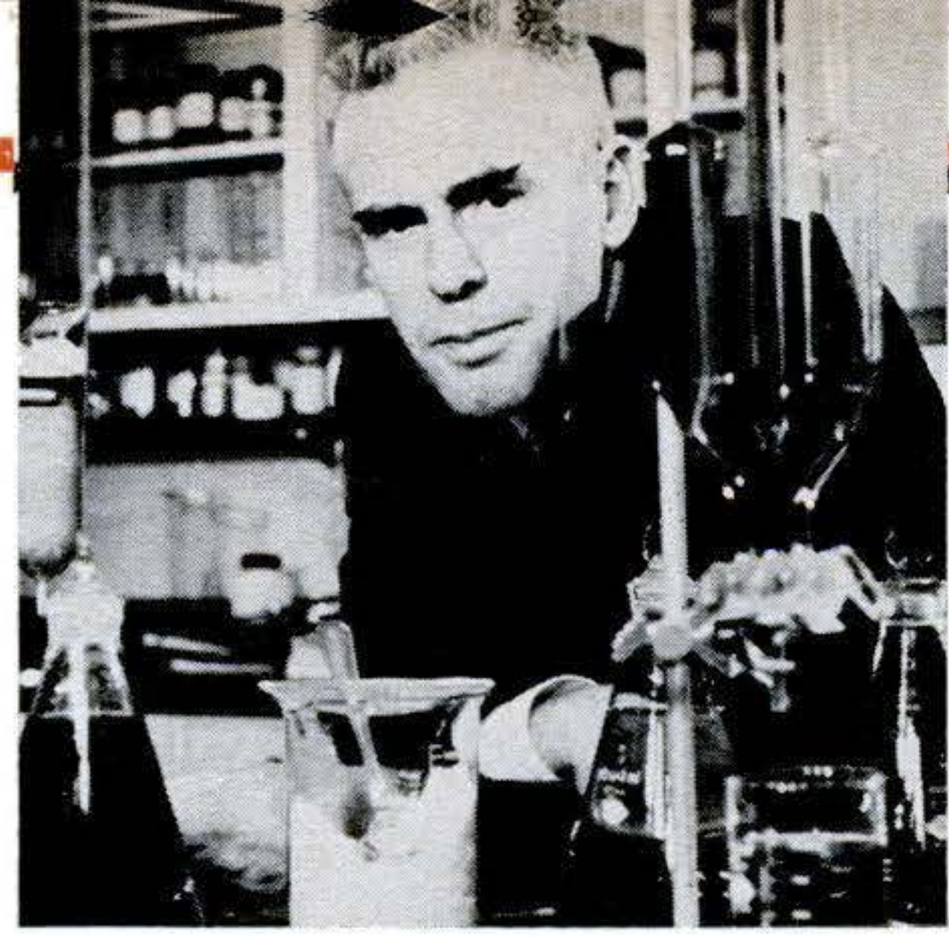
In an exclusive interview, our hard-hitting Food and Drug Commissioner, Dr. James Lee Goddard, speaks out bluntly on useless health gimmicks and food fads that cost consumers hundreds of millions yearly



search Council. This Board is generally recognized as the foremost authority on nutrition in the country."

Nutritional Quackery Widespread

What about his experiences with extravagant "shotgun" promotion of multi-vitamin and mineral supplements?

"Unfortunately," Dr. Goddard said, "nutritional quackery is widespread in the country today. And people waste a lot of money as a result. The Nutri-Bio food supplement is a notorious example of how the public can be misled by 'multiple-ingredient' products.

"It was promoted through one of the largest arrays of pseudo-scientific health literature ever assembled. It was recommended as the answer to practically all of man's health problems—anemia, arthritis, cancer, diabetes, frigidity, heart trouble, infections, and nervousness. It was even recommended for juvenile delinquency!

"These false and misleading claims were discontinued after institution of court action. Nutrition experts testified that some ingredients had no nutritional value whatever; others were not needed because ordinary diets supply them in quantities in excess of what is needed for good nutrition.

"Vitasafe was another preparation promoted with extravagant claims," Dr. Goddard recalled. "Again, court action was necessary to control this kind of misinformation on nutrition."

What kind of opposition is the FDA getting to its new regulations? "Affected industries—firms that make vitamin and mineral supplements, and some of the baking and cereal companies—have objected to various provisions," Dr. Goddard says. "And, of course, health-food stores complain that the FDA is infringing on their constitutional right to sell the products they wish to put before the public."

Among the items these stores sell are wheat germ and yogurt. Are such "health" foods authentic aids to nutrition?

"They are nutritious foods," Dr. Goddard says. "If you like them, eat them. But the same nutrients they contain are available in many other foods. In most cases, the FDA objects to false claims for such products, not to the products themselves."

Has the public been misled by advertisements of low-calorie foods to help you lose weight? "Foods such as salad dressings and gravies," Dr. Goddard replies, "may be greatly reduced in caloric content by the use of noncaloric thickeners. But because they make up such a small proportion of your diet, the reduction is insignificant in terms of the total calorie intake for a day. And in the case of so-called low-calorie breads, some haven't been low-calorie at all. Slices were simply thinner."

Pills, Tonics, and Lozenges

How valuable are other well-known health aids—vitamin C for colds, nerve tonics, blood fortifiers, liver pills, minerals and trace elements supposedly refined out of ordinary food, then put back in?

Goddard shoots down without hesitation the widespread notion that taking vitamin C will ward off colds. "There is no scientific basis," he says flatly, "for thinking this vitamin has an effect on colds." And on the subject of colds: Antibiotic throat-loz-

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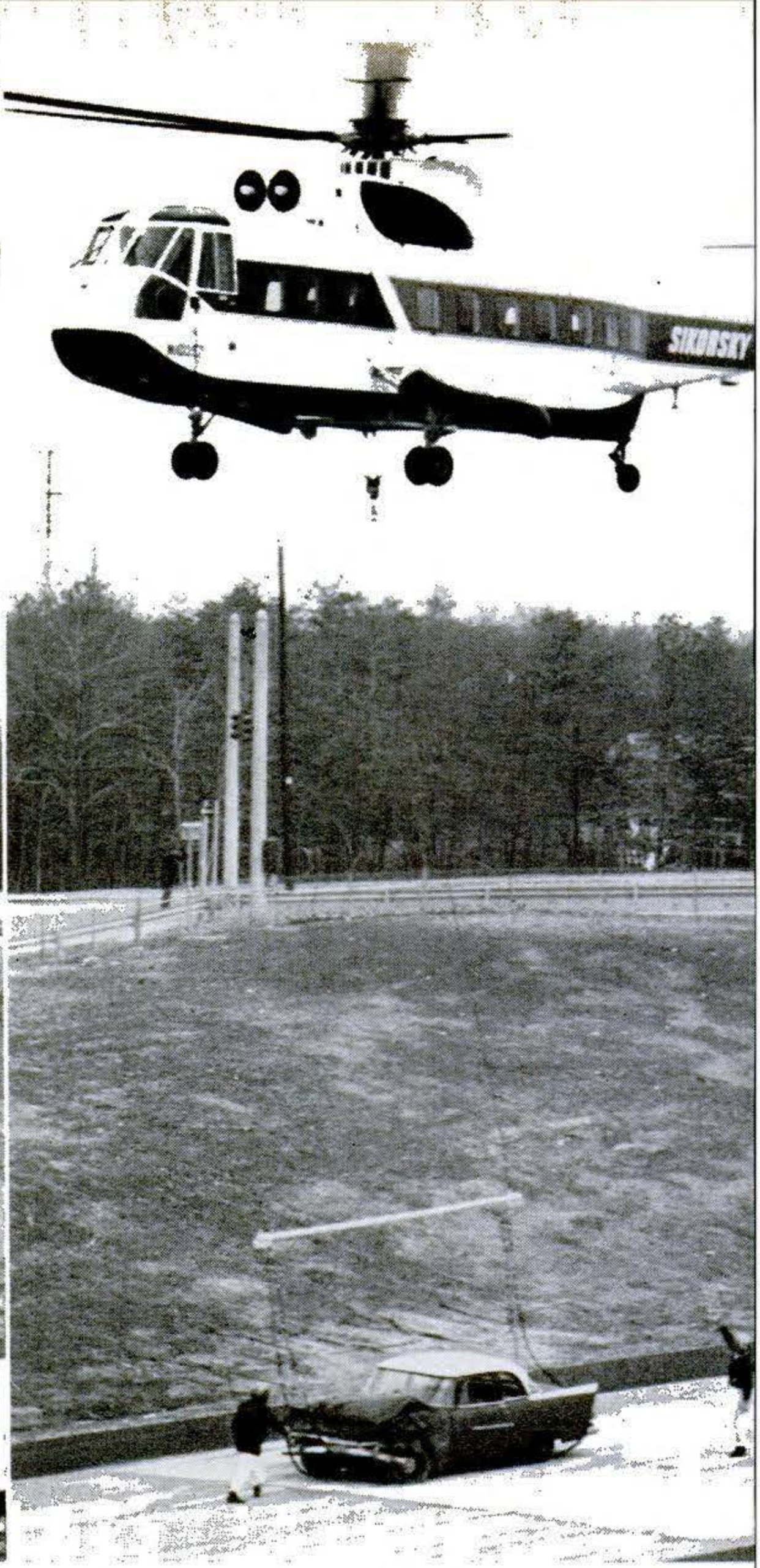

Here's how it's done: In first picture, above, big sling anchored to belly of hovering helicopter is run beneath one of two accident-damaged cars that have brought traffic to a complete halt in three

How Copters Can

Combining truck and ambulance, rotary wings could remove damaged cars, injured motorists

By DEVON FRANCIS
PHOTOS BY BILL MORRIS AND ORLANDO GUERRA

For years, engineers have been looking for a quick way to break mammoth traffic jams caused by accidents on heavily traveled highways. Now a group of men who have had this under study think they have one answer, anyway. It's helicopter "tow trucks."

The scheme has been demonstrated. It

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lanes. In second picture copter pilot is taking up slack in sling. In third, car is being lifted clear of highway to permit traffic to resume. Copter's two 1,400-hp. engines can hoist 6,744 pounds.

Solve Traffic Jams

works. One state legislature is considering appropriating money to study the clearing of wrecks from highways by air.

The choppers would have a second and equally important function—to speed persons injured in car accidents to the hospital.

The great virtue of the helicopter is implicit in its mobility. It's not tied to a narrow, clogged ribbon of concrete highway.

A chopper-truck could fly to the site. If the problem is only clearing the highway of disabled cars, it needs no place to land. It hovers, grabs the offending vehicles, and moves them out of the way. It can even pull two locked cars apart. That, too, has

Continued

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Lift-and-tow apparatus consists of series of cables and two-part spreader bar that attach to copter's belly, wrap around cars. Cables just above bar in foreground are used only to pull damaged cars apart.

Chopper can even pull apart two locked-together, damaged cars to speed

1 **This is what preceded** dramatic removal of battered cars in pictures on previous pages: Sling was assembled and tow cables attached to lead car of two locked vehicles involved in smashup.

2 **Hovering low,** copter puts tension on low cables and backs away to free first car from second. With a fully laden weight of almost 10 tons, it easily yanks two cars apart for a quick removal.

3 **Tow cables** have been detached by mechanics wearing crash helmets, spreader bar assembled and lift cables attached. Complete system would also include first-aid attendants and fire fighters.

4 **Rubber-wrapped cables** are passed lengthwise, successively, under each car marked for removal. In demonstration, first wrecked car was lifted to median strip; second beside highway.

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been demonstrated, as the pictures on the facing page show.

A planned chopper-truck system would include landing pads—"heli-stops"—alongside major highways at intervals of perhaps three miles. These would permit the transfer of injured motorists to convenient ambulances for swift delivery to a hospital.

Helicopter-trucks could operate day and night. Today's choppers are as much at home in darkness as in daylight.

Removing damaged cars by chopper is a fast operation. In the demonstration pictured here, the road was cleared of two cars in 20 minutes, including the time required to unload the components of a big sling and assemble them. Had the sling been attached permanently to the chopper's hull, as proponents of the system intend, traffic could have flowed freely again in five or six minutes. Estimated time for rescue work from the moment of receipt of an emergency call at a chopper's nearby home port to car removal: 10 minutes.

A number of different kinds of slings can be used. That pictured on the cover of this issue of POPULAR SCIENCE is only one of them. The sling used in the demonstration —staged at the far eastern end of one of the nation's most heavily traveled superhighways, the Long Island Expressway in New York State—actually was borrowed from a cargo-ship loading boom.

The idea for airborne traffic-clearing developed from a study called "Metro 66," a disaster plan for big cities, plus experience derived from military rescue work.

Manufactured by Sikorsky Aircraft, the chopper used here was identical to those flown by short-haul airlines in Los Angeles and San Francisco. Oil companies employ it between land and rig in offshore drilling. In another version it's a Navy antisubmarine craft, based on carriers in the Gulf of Tonkin. In the Mercury series of space flights, it picked up astronauts after splashdown.

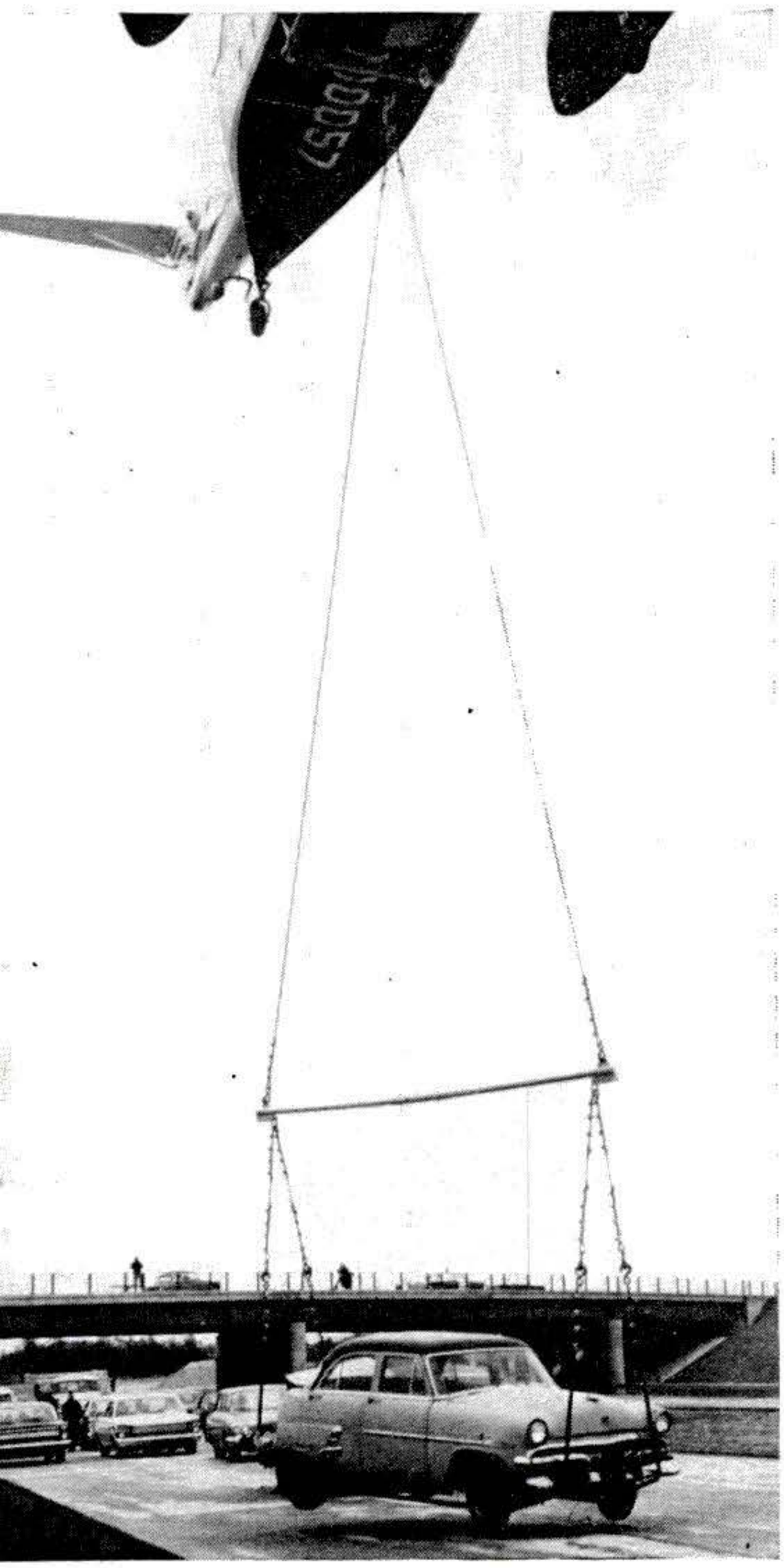
The pros and cons. Not everyone is sold on the idea of the traffic chopper. It would fly only in emergencies. It's expensive. Proponents hoot that down by saying sure, but fire departments are on standby, and are expensive, too. Besides, they add, what's the real cost of accident-incurred traffic jams in money and human lives?

Dr. John Parks, dean of George Washington University's school of medicine, says he believes state highway patrols probably will develop helicopter ambulances to transport doctors and medical equipment to the scenes of accidents.

The most caustic criticism after the demonstration was that the downwash from the chopper's rotor blades gave nearby cars the shudders. And one traffic expert suggested that motorists who stopped to gawk would, at least in the beginning, cause a bigger traffic jam than that caused by the original accident.

But not for long. The copter would be in and out before you could say scat. PS

removal and break up traffic jam



5 Chopper lifts a car free to break traffic jam. In actual service, system would provide up to 15 litters for injured motorists to be sped by air from crash scene to "heli-stop," then to hospital.

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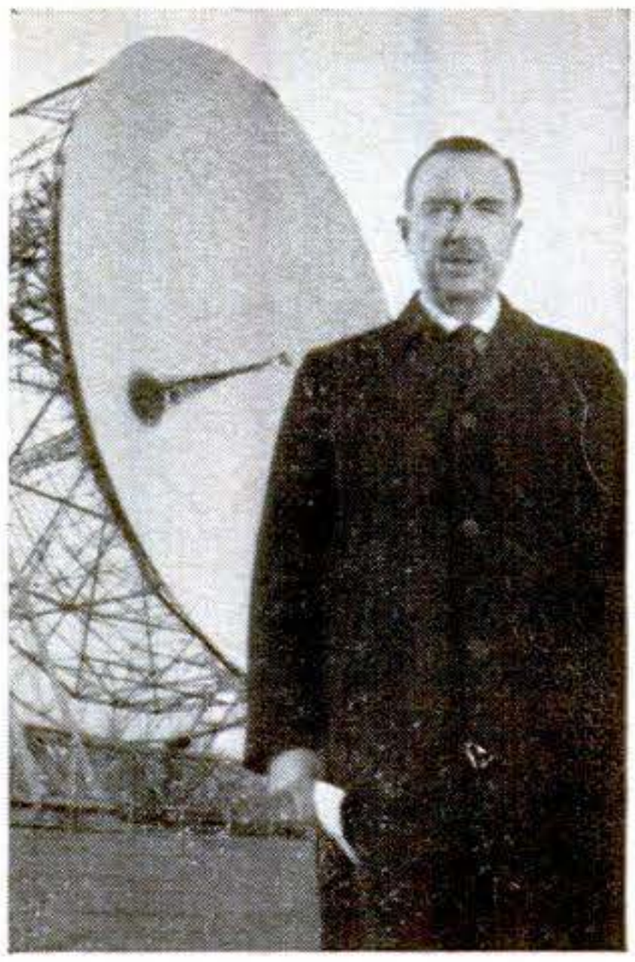


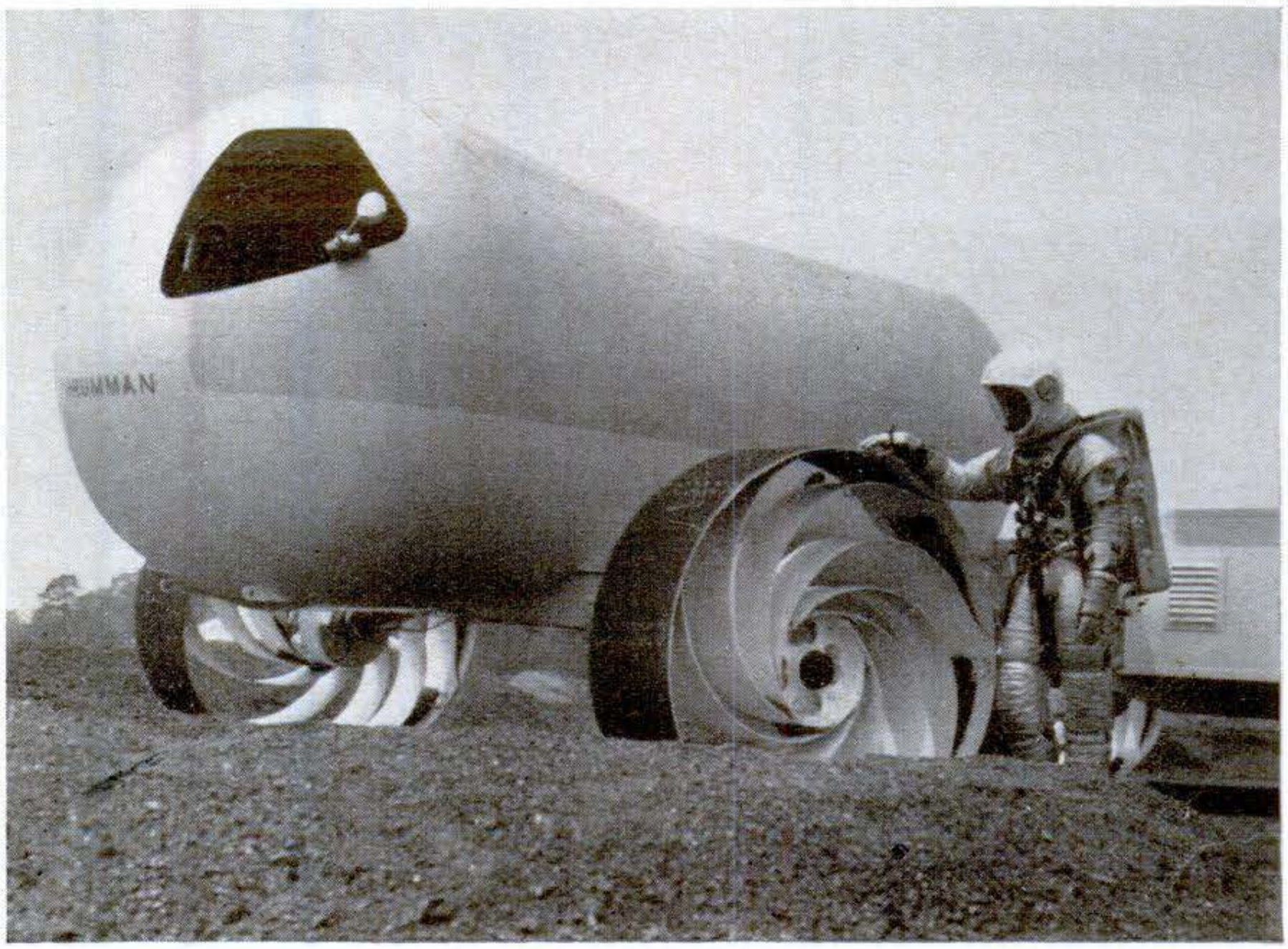
PS EXCLUSIVE

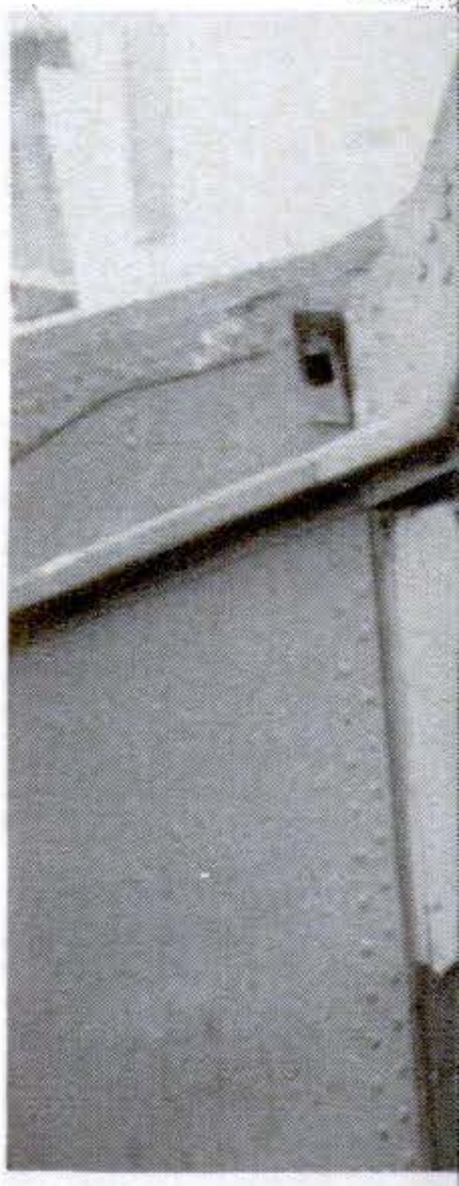
What will your future be like? Here is a startling glimpse into the year 2000 and beyond by one of television's best-known reporters—who has actually "been there"

THE TWENTY-FIRST CENTURY:

The World You'll Live In

By WALTER CRONKITE





Tomorrow's transpo tion: Hovercraft fe cuts hours of time tween San Francisco ports by crossing la and water at 80 m.p Use of versatile cushion vehicles, wh are steadily being proved, will greatly crease by the year 20 Above, Cronkite is in pilot's seat.

Weird-looking moon is Grumman's MOL which is designed travel through crat and over obstructi under airless, low-gr ty conditions. Inte houses airlock, liv and sleeping quart for astronauts explor the moon's surface.

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In a very real way, I've traveled 33 years into the future—to the year 2000 and beyond. As a CBS News correspondent responsible for a television series called *The 21st Century* [CBS-TV, Sundays at six p.m. Eastern Time], I've tested some of the hardware of tomorrow: the vehicles with which we may explore the moon, the automatic cars in which we'll ride to work, the research submarines that will take us to the ocean floor. I've talked to scientists, engineers, doctors, many eminent authorities who have given me a truly revealing glimpse of the future.

As part of *The 21st Century* I've had a medical checkup by a "mechanical doctor," helped pilot a hovercraft, listened in on signals from outer space at Jodrell Bank, eaten artificial foods used in our space program, and talked to scientists about what life will be like just 33 years from now when the earth's population—now about three billion—numbers six billion.

Driving on the moon. What's it like? Well, we can give you a pretty good idea. At Peconic, Long Island, Grumman Aircraft has built an artificial moonscape to test their Mobile Base Simulator or MOLAB.

MOLAB is an electric four-wheel tractor-trailer every bit as fantastic as the rest of the space program. The huge, weird-looking barrel-hoop wheels with flexible spiral spokes, driven at the hubs by reversible electric motors, will take MOLAB over the surface of the moon. They're also what makes MOLAB fun to drive.

The wheel spokes and rims are so limber the vehicle almost seems to float—it's like an amusement-park ride. You go bouncing

Continued

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through craters and over obstructions; even movement *inside* the vehicle causes it to shake like a bowl of Jell-O.

I set a new speed record: 12 m.p.h. If this seems unimpressive, remember that this buggy is not designed for speed. It takes wide treads and those sagging wheels, which give a footprint three times larger than a round wheel, to keep the vehicle upright as it goes churning through craters.

Computerized cars. I drove a car for use right here on earth that was equipped with General Motors' DAIR system [Driver Aid, Information and Routing; PS, Nov. '66], which goes a long way toward automating driving.

With DAIR, when you want to take a vacation trip, your gasoline company gives you a card—a tour-guide, that looks like a credit card—instead of the usual map marked with a heavy red line. In your car is a device that resembles the receipt-writing gadgets used with credit cards. You simply push your card in, press a button, and you're ready to go.

As I drove the test car, DAIR navigated for me, telling me when to go straight, turn left, turn right, and so on. How does it work? Its decoder responds to magnets imbedded in the roadway.

Another part of the system is a dashboard display panel for road information. As I drove around the GM test track, speed limits and other traffic signs flashed onto the panel activated by low-power transmitters along the roadway. As part of the demonstration, a voice override came up and said, "Caution, accident ahead," and then, a bit later, "Icy road." I also tested the built-in telephone, based on simple Citizens Band radio equipment, which is part of the DAIR system. You dial a coded emergency message which connects you with the police or a garage.

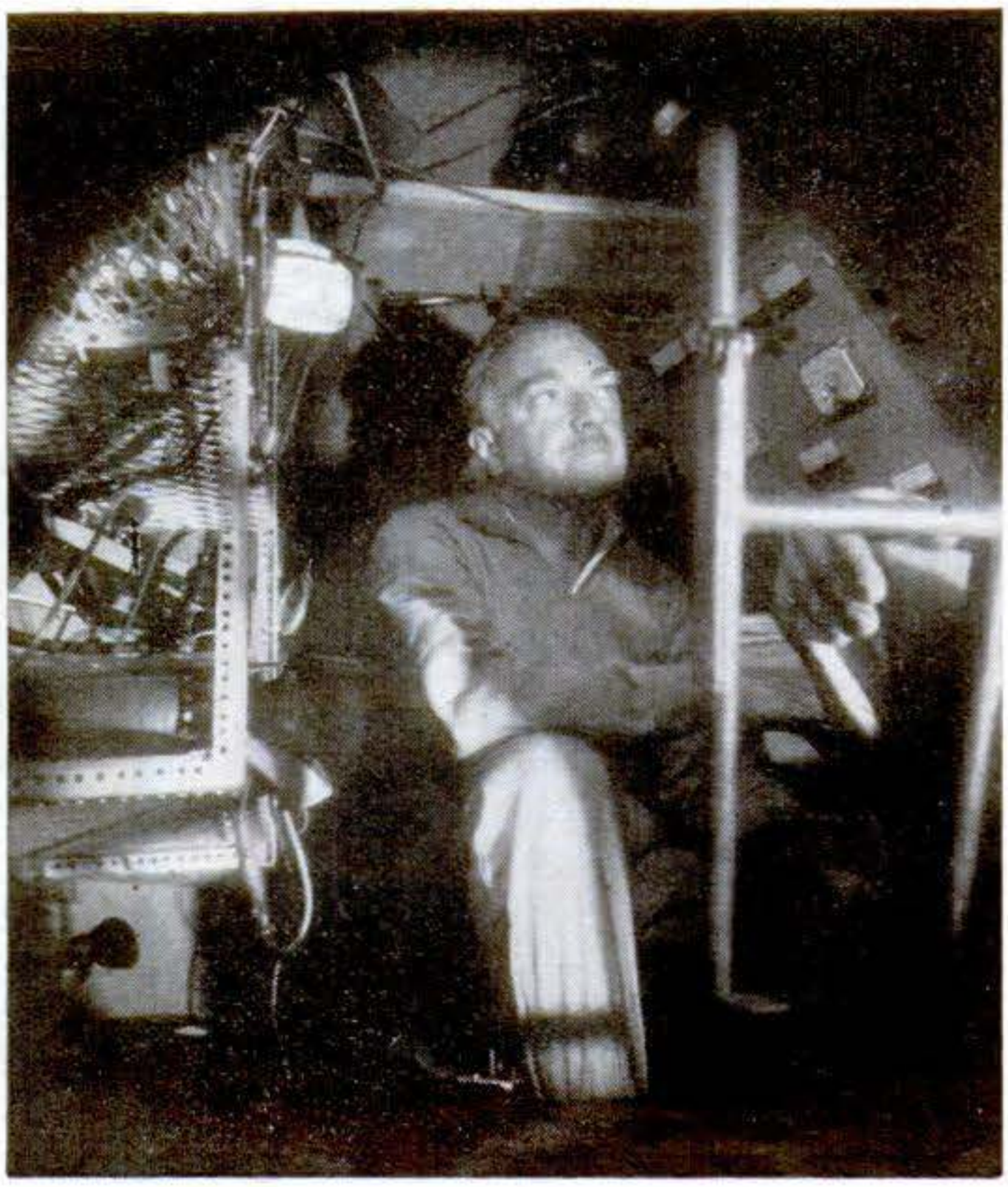
Far-out vehicles. Another type of transportation in the 21st century may be the road-rail Alden StaRRcar which I drove on a highway, and then rode in as it traveled, completely automatically, along an electrified rail. It's a two-man electric car. In the future, such tracks may carry your car on commuting runs and long cross-country trips. When you arrive at your destination, you'll simply drive off the track and have your car free for local travel.

I've also driven other far-out vehicles: GM's single-stick-control Eight Ball and the Chrysler 300X, to mention just two. I flew across San Francisco Bay seated beside the pilot of a hovercraft [PS, Aug. '65] and I traveled to the ocean bottom in a research sub, the Westinghouse Deepstar-4000.

My underwater trip to the continental shelf 2,500 feet down, 13 miles off San Diego, brought me to a surprising spot as barren as a desert. With all its barrenness, though, I learned that much of the world's wealth—minerals, petroleum, and foodstuffs—lies beneath the ocean. In the 21st century, as never before, we will be depending on this underwater wealth for survival.

How you will live. Through the window we've opened into the 21st century we've seen miracles in the biological sciences that will mean a longer and happier life for all. Eventually, the doctors told me, we will replace almost every body component as it wears out: kidneys, heart, bones, to mention just a few.

Another feature medicine will offer i



Deepstar-4000 is one of the research submarines exploring a new frontier: "inner space." By the 21st century, Cronkite says, men will live and work in the ocean, exploiting its abundant riches.

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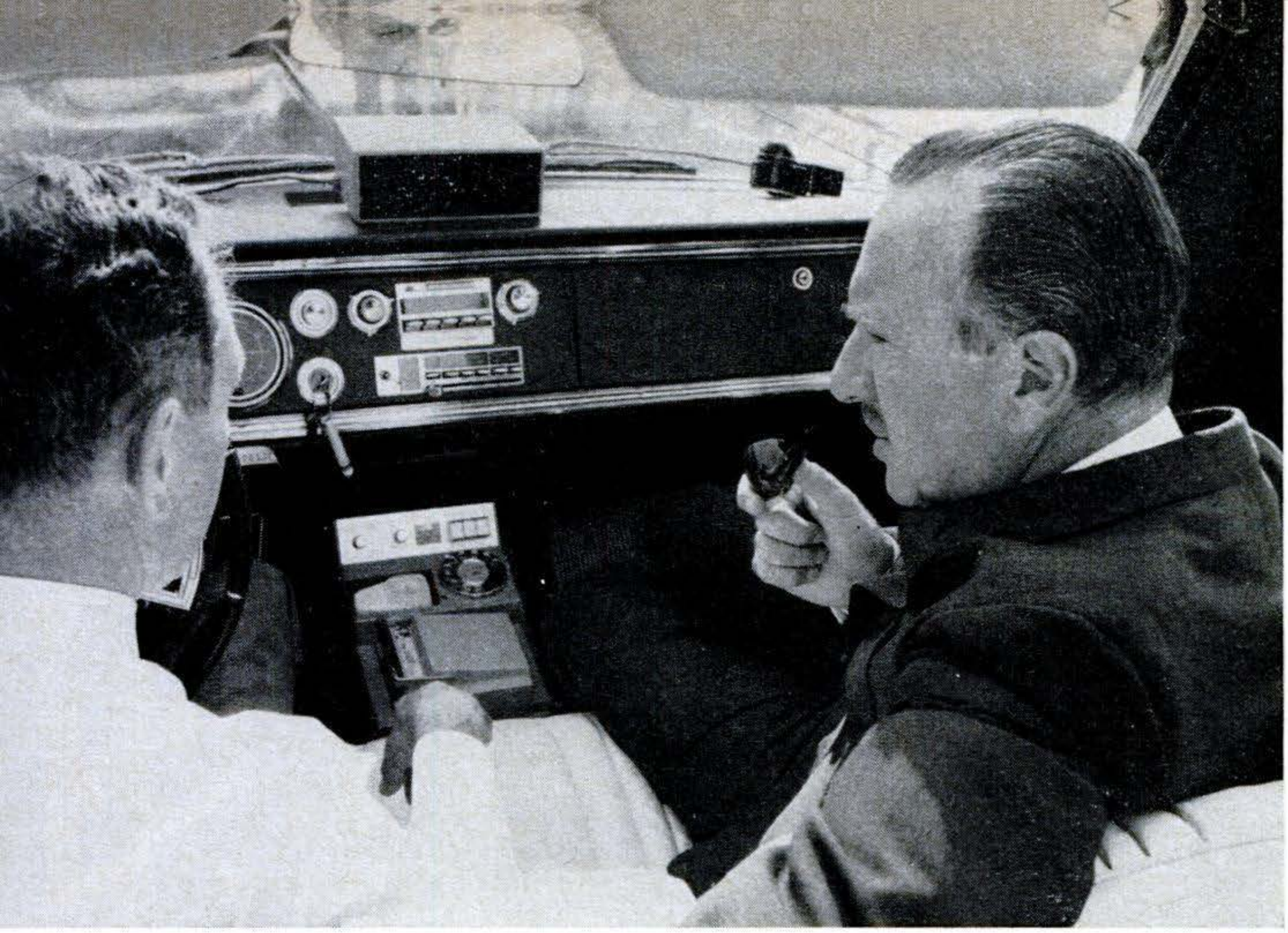

First step toward automated car is GM's DAIR system. Floor unit includes decoder, which relays trip instructions, and an emergency radiotelephone. On dashboard, panel flashes road signs and signals.

years to come is a "mechanical doctor"—like Philco's medical monitoring chair [PS, Sept. '66]. It looks like an ordinary office chair. I sat in it fully clothed with my hands on the arms. I felt no sensation. A slight bulge at the back held a microphone. I was told there were concealed sensors in the arms. In a few seconds, the doctor showed me my examination results: a complete electrocardiogram as well as other tests, neatly printed on graph paper.

In filming *The 21st Century* for CBS (it is sponsored by Union Carbide), we have visited homes of the future, talked about what your food and furniture will be like. I'm convinced that in the home of the 21st century all those nuisance chores you and your wife now have to take care of will be done by robots. Hard to believe? Well, I watched model robots built by Prof. M. W. Thring of Queen Mary College in London do such things as handle tools, walk, talk, crawl, and demonstrate other remarkable skills. The robots are small prototypes; each has the artificial "organs"—"arms," "legs," "eyes," or "voice box," for example—required to do a particular job.

What about money? For some thoughts on what your income and standard of living will be in the 21st century, I talked to futurist Herman Kahn, Director of the Hudson Institute. He told me that the average household income after taxes in the year 2000 might easily be $15,000 to $25,000.

Despite the increase in your income, you will work only four days a week, 7½ hours a day, have three-day weekends, 10 holidays a year, and three-month vacations!

What does the 21st century hold? After doing such things as joining in while a computer-synthesized voice sang *Daisy*, sitting on furniture made entirely of paper (very sturdy), and watching the operation of a kilowatt laser capable of blasting rock to dust, anything seems possible.

It seems probable that we will not only explore the moon with our lunar vehicles, but that we'll mine it for minerals we can use, and colonize it as well. During the 21st century we'll visit and explore the planets within our solar system.

After having lived in the future as far as it is possible, I can tell you that an exciting prospect is in store: We will lead richer lives, go places we have never been before, and do things undreamed of today. PS

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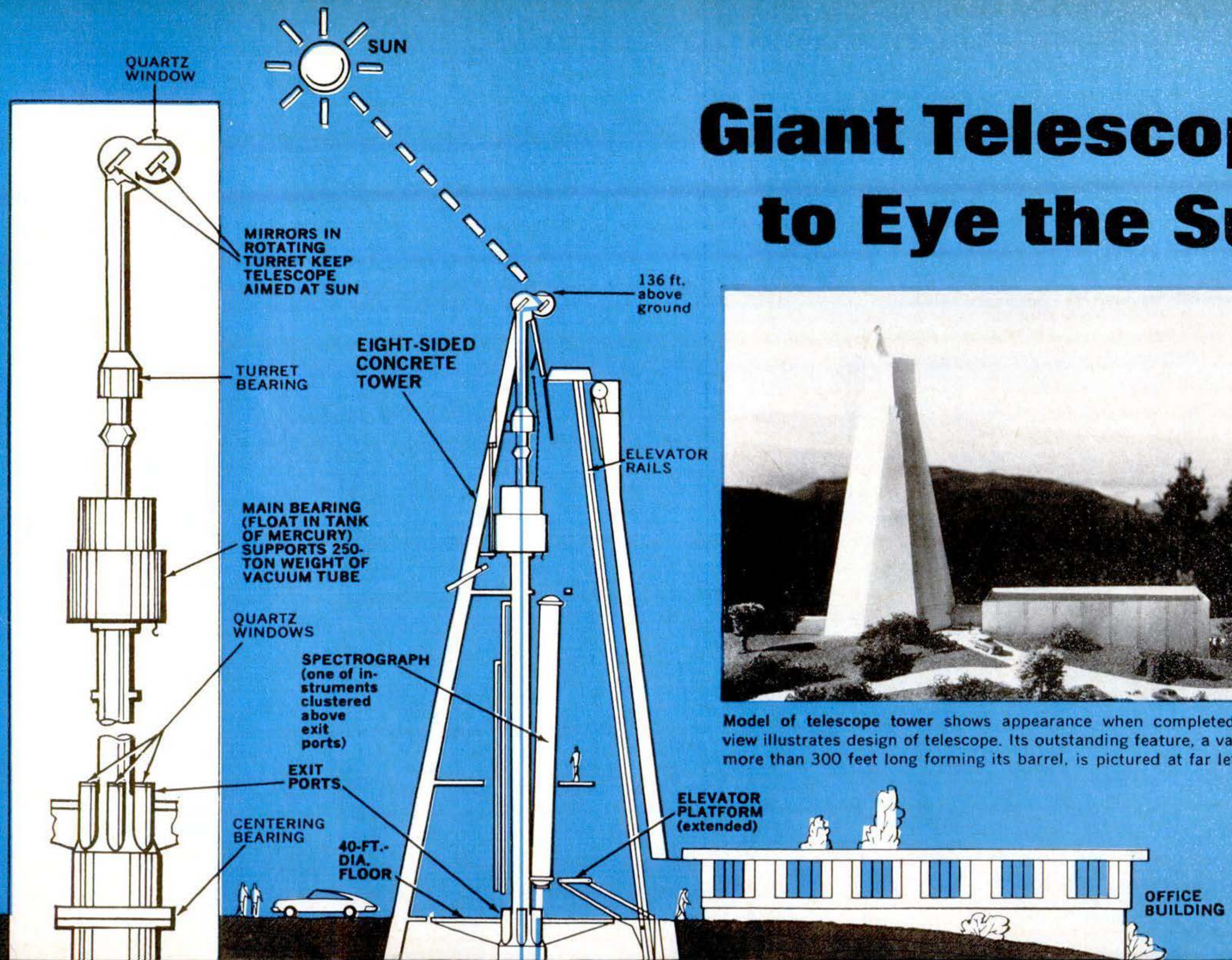
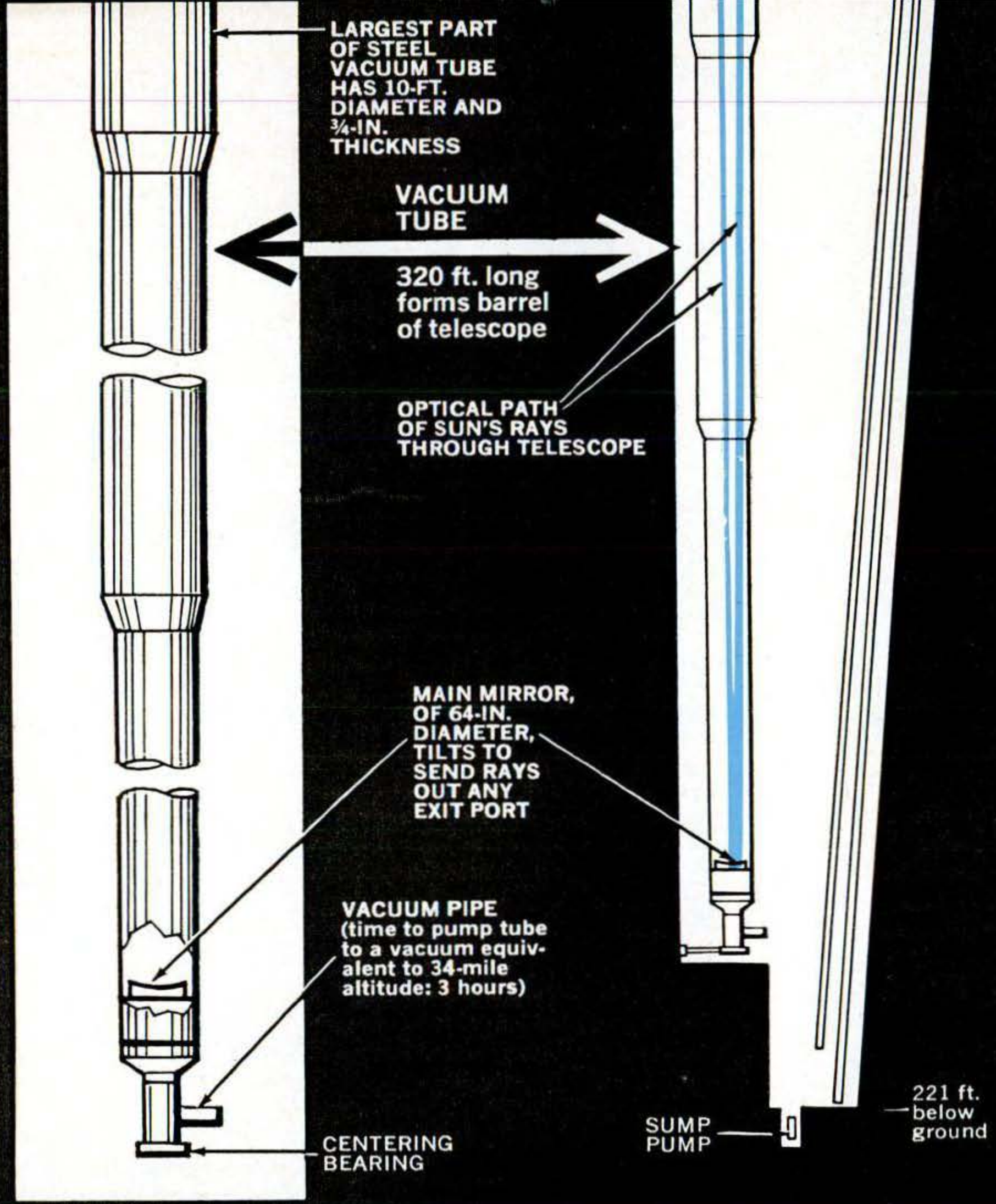
Giant Telescope to Eye the Sun



Model of telescope tower shows appearance when completed. Cutaway view illustrates design of telescope. Its outstanding feature, a vacuum tube more than 300 feet long forming its barrel, is pictured at far left.



A steel vacuum tube 320 feet long and up to 10 feet in diameter will be up-ended on a mountain top at the Air Force's Sacramento Peak Observatory, Sunspot, N. M. Fitted with mirrors and windows, sunk nearly 200 feet deep, and enclosed in an octagonal concrete tower above ground, it will become a giant telescope to study the sun.

Now under construction, the new $3,160,000 solar telescope will use a 64-inch concave mirror of 180-foot focal length to form a 20-inch-diameter image of the sun's surface. It will rank second in size only to the huge solar telescope at Kitt Peak National Observatory, Ariz. [PS, Nov. 1962]. And it will have an important advantage over all others: vacuum. Its vacuum tube provides an air-free optical path that will yield a clearer view of the sun, by eliminating image "dancing" due to turbulence in sunlight-heated air currents.

One practical use of the completed instrument will be to aid in forecasting periods of great risk to astronauts—when bursts of radiation from the sun would be likely to imperil them on long space missions—and other periods with a minimum of risk.

How the vacuum-tube telescope will work is shown in the drawings at left. At its top, rays from the sun enter a 30-inch quartz window of a swiveling turret and are reflected by flat 44-inch-diameter elevation and azimuth mirrors, straight down the tube. At its bottom, the main 64-inch mirror returns the rays in a focused beam—which may be directed, by tilting the mirror slightly, to any one of five exit ports fitted with 24-inch quartz windows. Large observing instruments such as spectrographs will be mounted vertically, just above. Smaller gear may be placed horizontally, and the focused beam directed to it by an auxiliary mirror above a window. Atop the tower, a TV camera with a 180-degree field of view will keep indoor observers advised of clear or cloudy skies.—*Alden P. Armagnac.*

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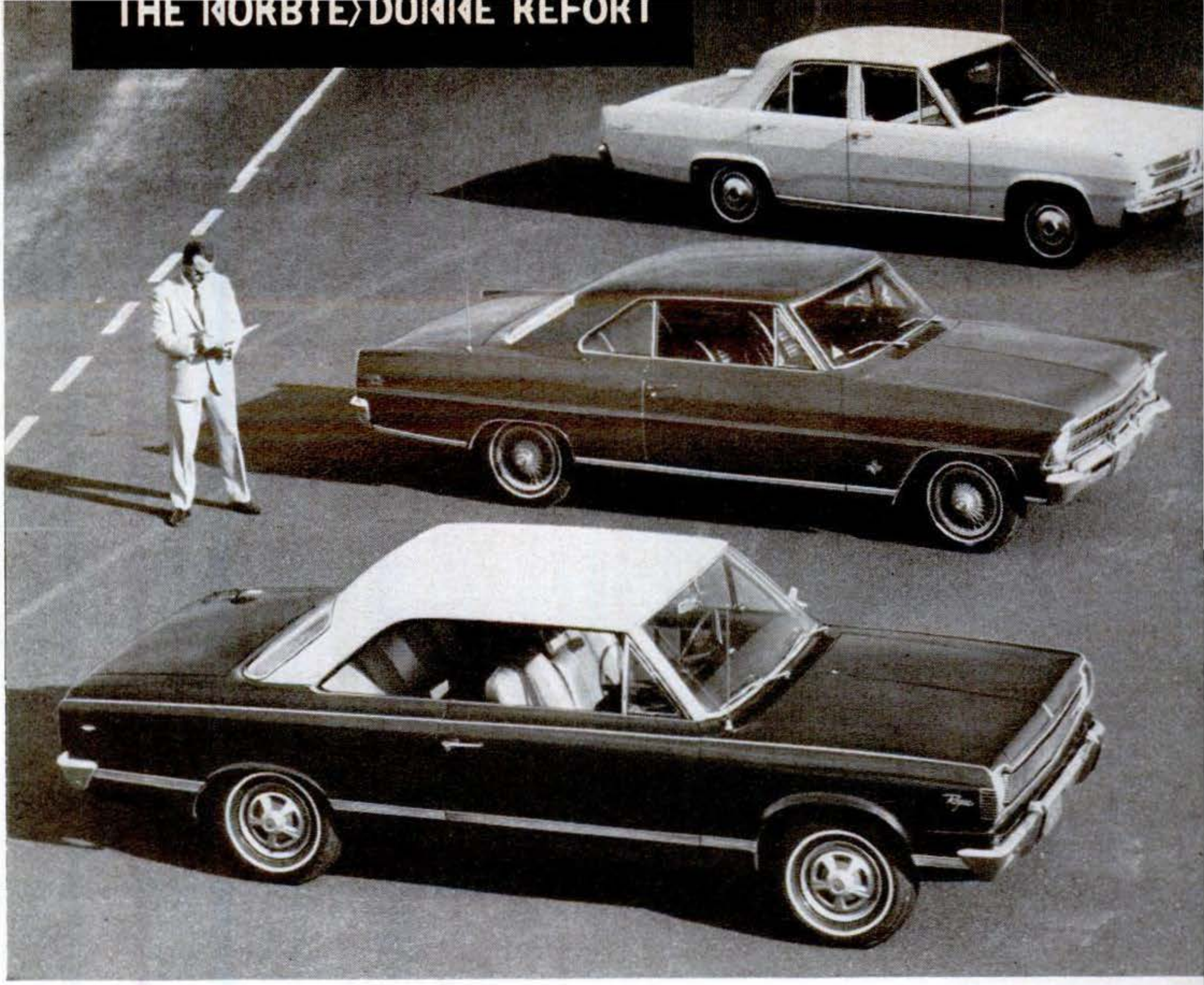

Lined up, Rambler American Rogue in foreground, Chevy II Nova SS (center), and Plymouth Valiant Signet show general uniformity of styling: short hoods, long decks, maximum "greenhouse" areas.

The truth about the compact cars:

Plymouth Valiant, Chevy II

The new compacts offer power options, sports models, sleek styling. How do they stack up? Two PS experts tell you: Norbye rates them on the test track, Dunne on everyday, family use

By **JAN P. NORBYE** / *PS Automotive Editor* PHOTOS BY BILL MORRIS

A funny thing has happened to compact cars. They burst on the market eight years ago with a fanfare about economy, but look at them now: Some have grown up into not-so-compacts [PS, Mar.]. Others, still compact, have gone snooty!

Want a V-8 engine, bucket seats, four-on-the-floor, sporty interior? Just ask the salesman. Style? The compacts have gone from sleazy to sleek. Power? Hah! Take a look at our spec table.

In overall dimensions, the American is the smallest U.S.-built car. It was sold only with sixes until last spring, when a brand-

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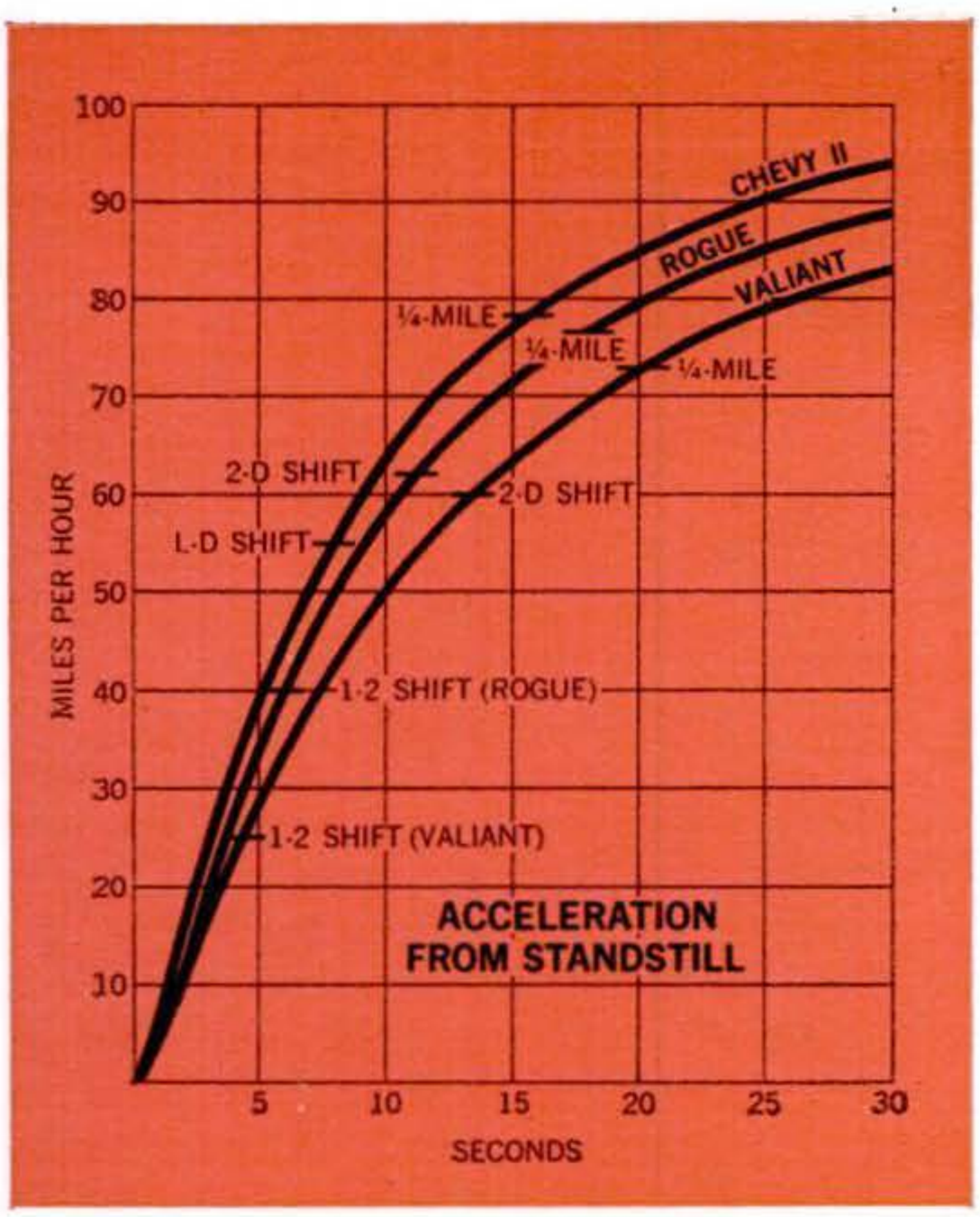
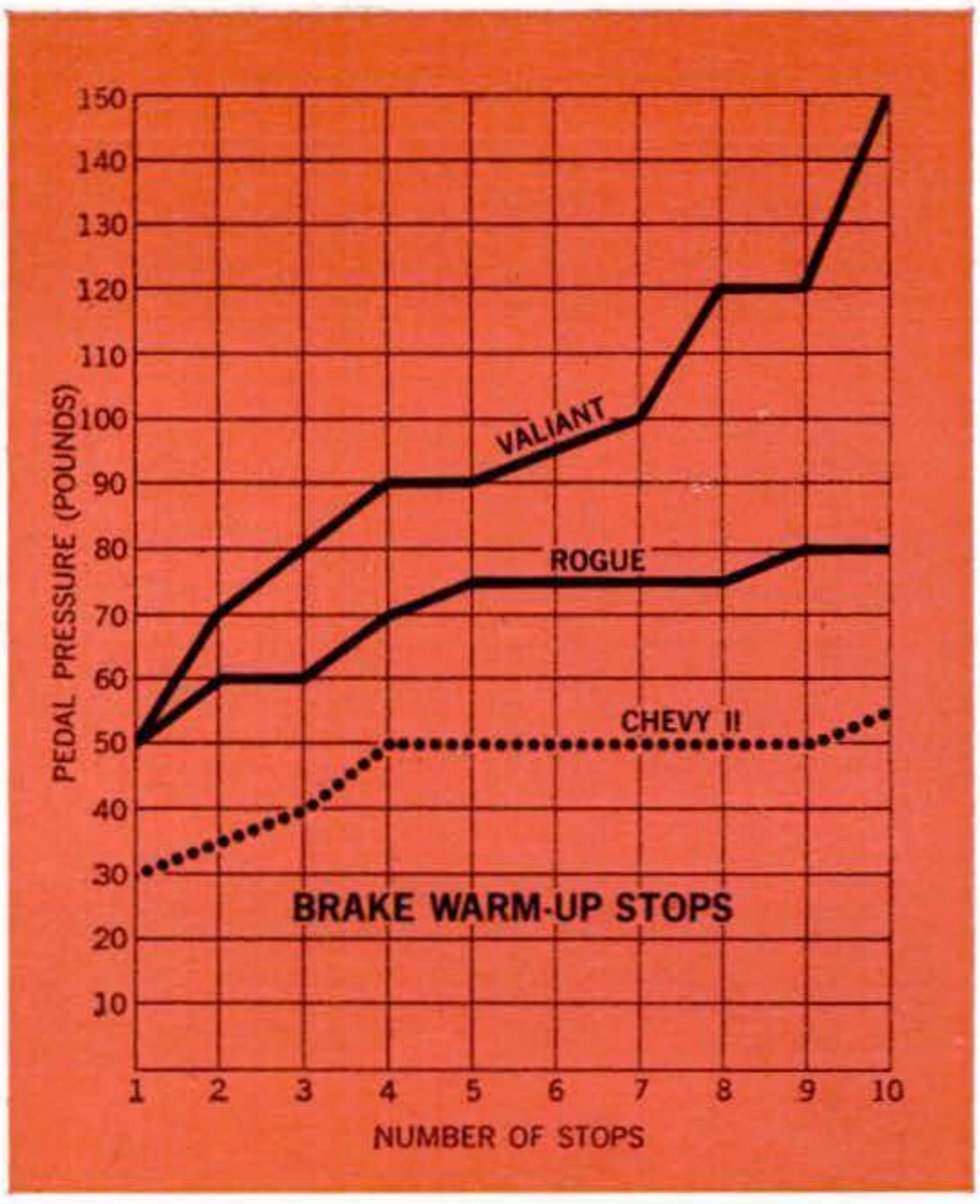
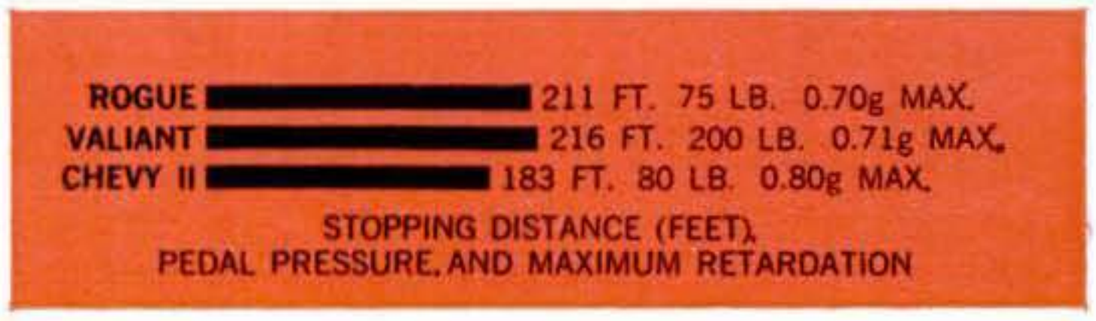
Chevy II's hot V-8 did standing ¼-mile in 15.7 seconds, Rogue's V-8 in 17.5, Valiant's six in 20.2.

Chevy II recorded shortest stopping distance in final stop, but side pull set in during warm-up.







nd Rambler American

new 290 V-8 became optional. Powerful and willing to rev, it's a honey on the road, though our test car proved greedy for gas.

And the Chevy II? Not only can you get your Chevy II with the workhorse 283-cu-in. V-8—there's also a pretty wild four-barrel 327, straight out of the Corvette!

Most Valiants are sold with the lively 225-cu.-in. slant-six—the standard 170 mill is the economy choice. The V-8 option is a 273. The 225 six is a surprising engine, with such tremendous low-range torque that it pushes some smaller V-8s in performance. In a light car like the Valiant, this engine is particularly impressive.

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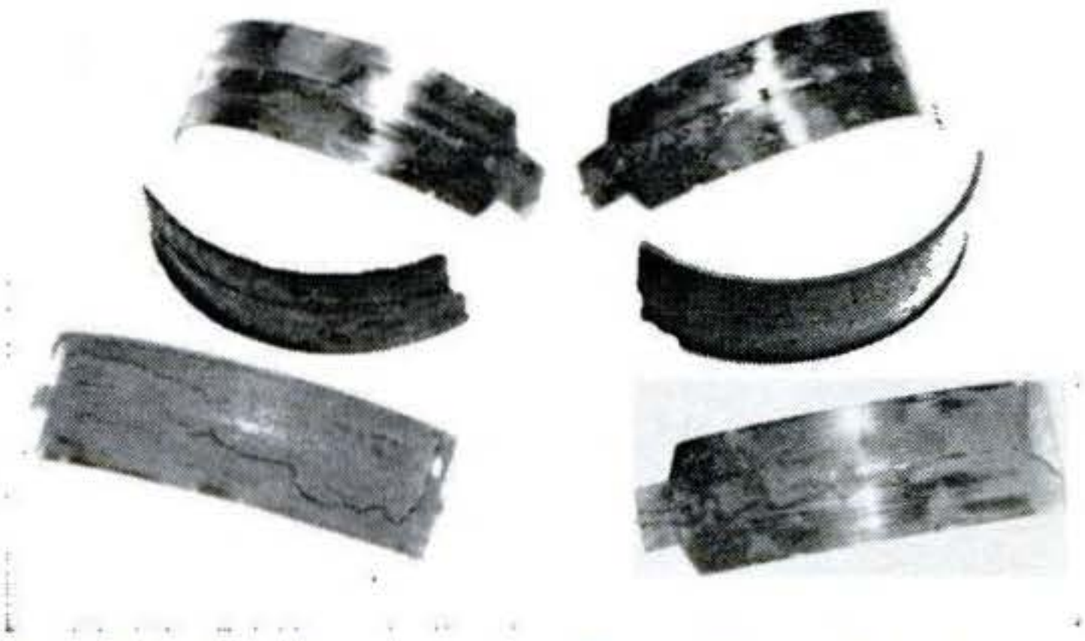

Front brake linings on the Chevy II had failed completely by the time we finished testing. We suspect severe abuse before we got the car. In later tests of second Chevy II, brakes stood up okay.

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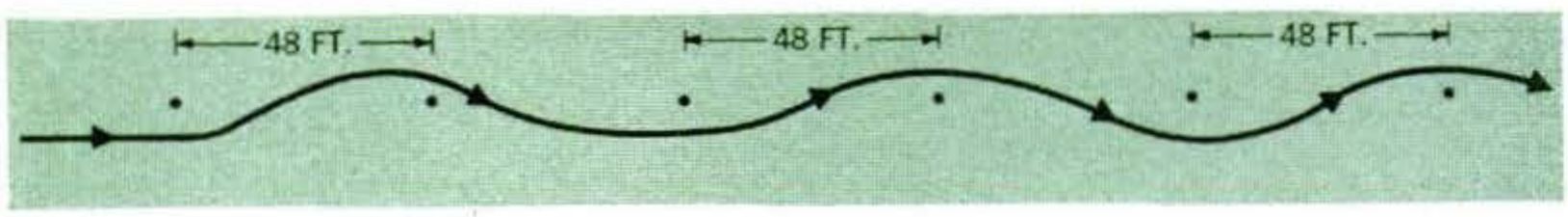

In the slalom test, the Valiant was best, with a steady speed of 27 m.p.h. The car was capable of making a single turn at 30, but the power-steering pump would catch on steering reversals at that speed. The Rogue ran up to 24 m.p.h. but the Chevy II could do no better than 20 m.p.h.

We felt that the 327 V-8 Chevy II, 290 V-8 American, and 225 six-cylinder Valiant gave us the most interesting engine available for each car.

The brakes. The new-day compacts do have some debits. All three of our test cars had standard brakes, with drums all around.

Valiant took 55-m.p.h. turn with side thrust of 0.84 *g*, moderate body roll, balanced yaw attitude.

Chevy II, on same turn, lifted inside rear wheel, could maintain only 0.65 *g* lateral acceleration.

Rogue showed steady side load of 0.87 *g* with little body roll and slight slip angles at front and rear.

Only the Chevy II had power assist. After testing the brakes of the three cars, I'm sorry to report that brake systems on compact cars haven't kept up with the improvements made on the larger cars.

In the Valiant, I experienced bad fading fairly early. On a 12-percent gradient, the brakes couldn't hold the car after the ninth warm-up stop. Recovery was quick, but on hard braking the left rear tended to lock.

The Chevy II had the shortest stopping distance and the least fade. Left side pull began on the seventh stop. Later, it would pull in either direction. With continued driving, following acceleration testing and further heating of the brakes, the bonding between the primary brake shoes and linings let go. Inspection showed the secondary linings almost fully disintegrated.

My theory on this failure is that the brakes had been severely abused early in life, perhaps in the first 100 miles, and the damage was intensified by the stresses and temperatures the brakes were subjected to in my tests.

Later, I ran another Chevy II, standard brakes, through the same test. Fade and side pull set in as before, but no failure occurred. This supports my belief that what happened the first time was a freak incident.

The handling tests. Our side-thrust test shows a car's ability to negotiate a sudden turn at abnormally high speeds. The turn has a constant radius of 255 feet, and entry speed is 55 m.p.h., with full throttle acceleration until a car's limit for the turn is established. Side load is measured on a Tapley meter, which records lateral acceleration in fractions of one *g* (equal to 32 feet per-second-per-second). In normal driving, you rarely exceed .65 *g*.

The Valiant maintained .84 *g* throughout, at steady speed with moderate body roll.

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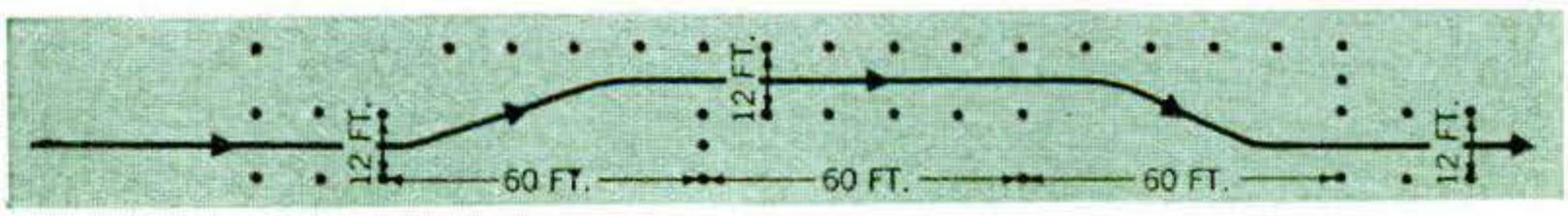


In wiggle-woggle test, Rogue made several clean runs through grid at 65 m.p.h., equaling the Dodge Dart's performance last month. Steering was light and precise, with no threat of pump catch. Valiant reached 60, when pump catch set in. Chevy II had a maximum stable limit of only 55 m.p.h.

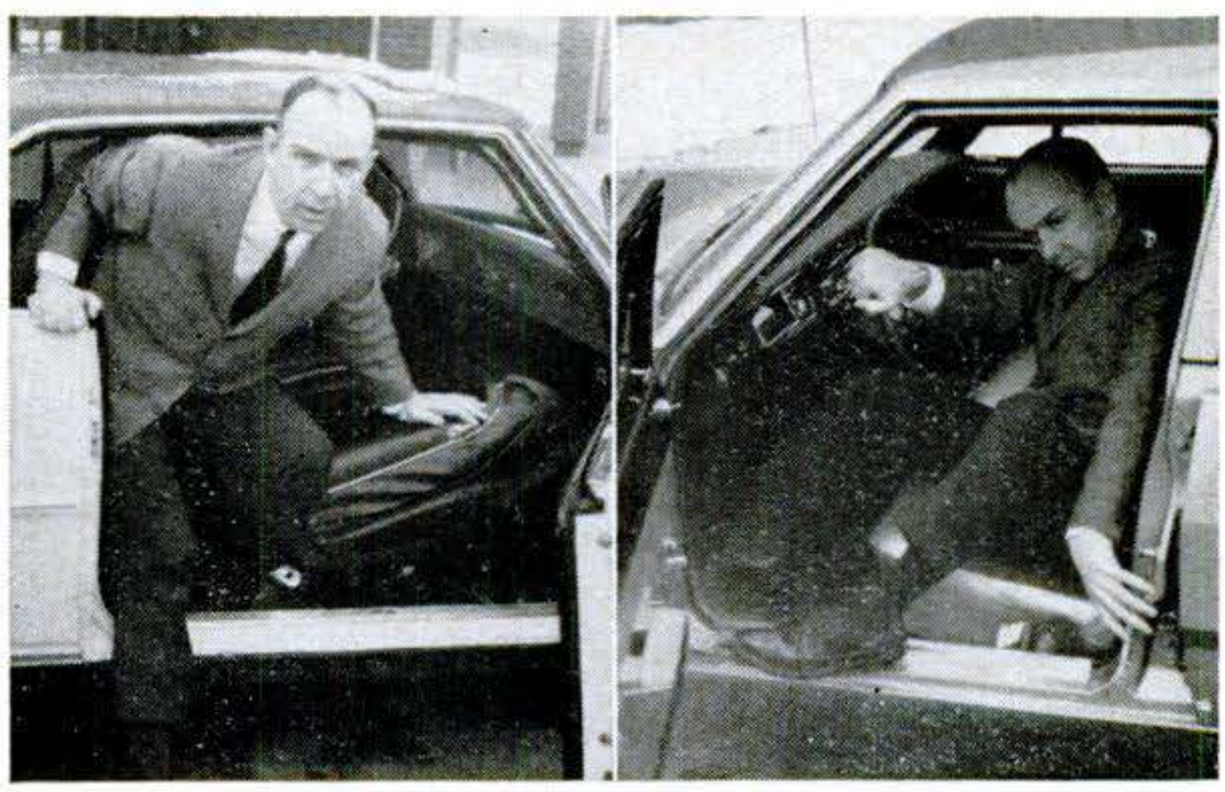
The Rogue was about three m.p.h. faster and recorded .87 with little roll. In the Chevy II, weight transfer due to lateral acceleration unloaded the inside rear wheel to the point of wheel-spin in the .75-.80 *g* range, and side thrust fell to .65 *g* as soon as the wheel lifted and speed diminished.

The Rogue came out best in the wiggle-woggle; the Valiant was fastest in the slalom. In both the Rogue and the Chevy II I was ill at ease in the slalom—they needed too much work with the steering wheel. In the wiggle-woggle, the Nova SS proved to first understeer, then oversteer.

Practical Size, Good Visibility, but Problems with Noise and Discomfort

By **JIM DUNNE** / *PS Detroit Editor*

Reclining seat in Rambler's Rogue lets Junior lie down and nap—with lap belt securely fastened around his waist.



Getting out of the Chevy II's back seat is not as difficult as it looks (left) thanks to a wide door. Valiant's front seat (right) makes exit tougher because of high door sill.

Yup, they've changed, these compacts. Take driver visibility. It's superb on the American and the Valiant. The Chevy II's windows aren't deep enough to be rated excellent, but vision is still quite good.

If you want to quarrel with the passenger space available and the austerity in comfort, what do you expect for the price? The fact is, each of our test cars exhibited certain splendid interior features.

The bucket seats in front on the

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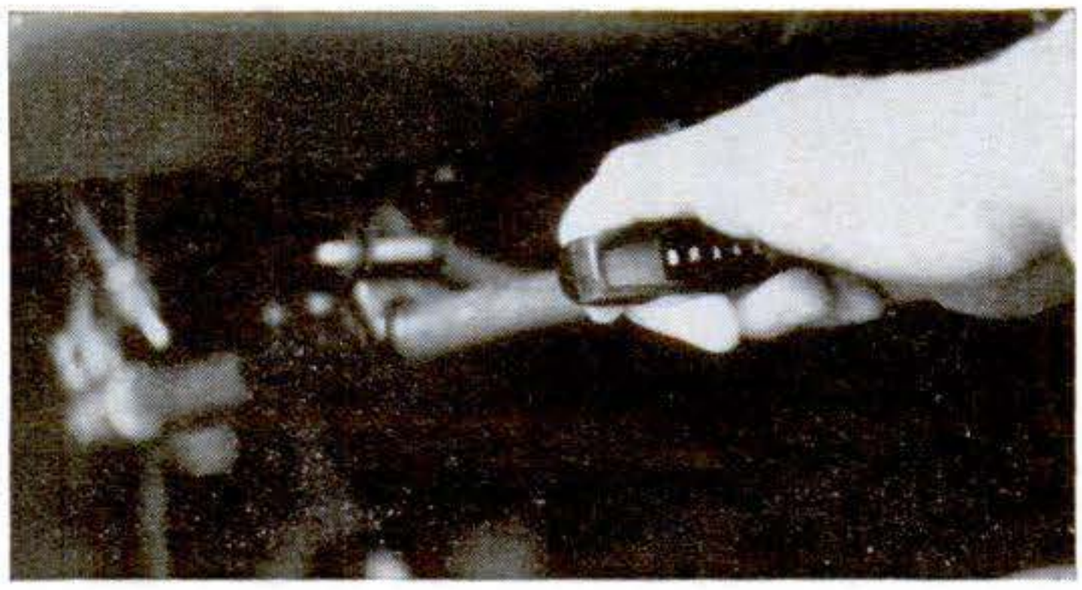
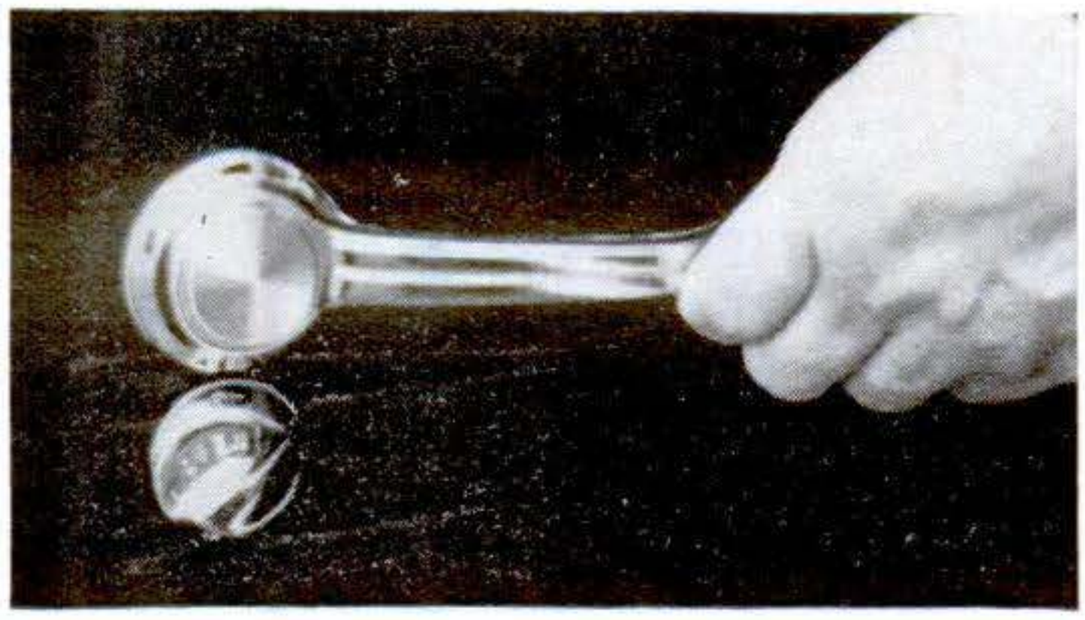
Knee and foot room in rear of Chevy II is scant, but seat is low enough to give ample head room.

Valiant offers good comfort in rear; four-door body provides easy access. Note rounded seat corners.



All three cars have hand-operated parking brakes; Valiant's (above) is not easily used under dash.



Button under door handle turns to lock Chevy II's door. We found it less handy than a sill button.

Chevy II and the American provided plenty of room. The back seats didn't. That tilt-back seat in the American was great. The Valiant had the most room overall on the inside, a boon to the family man.

No report on a class of cars is complete without some nitpicking, however, and I'm just the man to do it.

The din. One design gimmick common to all three cars is the placement of the heater fan inside the passenger compartment. After a while the noise gets to your ears.

There are other noises, too. All three cars have unit-body construction. Insulation of road shock and ride vibration has always been a problem with unit bodies. Cars with separate frames usually have a quieter ride.

Rambler's transfer of road noise through the body to the passenger compartment is particularly noticeable, starting out as a slight noise at 30 m.p.h. and rising to a loud one at 70 m.p.h. Valiant has the least road noise of the three. Chevy II's road noise is moderate, but stays at about the same level as drive-line and wind noise, so it's difficult to distinguish.

Each car also has some wind turbulence outside the windows. This noise becomes severe at 70 m.p.h. But noticeable wind whistle is almost nonexistent. Only the Chevy II showed a tendency toward wind whistle, and then only at 60 m.p.h. and up.

Note to trippers. You'd better check luggage space. While the Valiant has excellent room for the size of the car, the Chevy II's trunk is every bit as small as it appears from the outside. The American's luggage space is good, but loading over that 32-inch-high opening makes it hardest to use of the three cars. Chevy II's loading height is 26 inches; Valiant's, 25. The Valiant also comes out best in height from trunk bottom to trunk opening—four inches. The Chevy II runs to eight, the American to 12½ inches.

Carburetor flooding was a serious problem in the American. It happened four times in eight days of driving, each time on cold starting.

Overall, I liked the Valiant best, because of its roominess, easy handling, and thoughtful design. The Rogue is a lively car, but a bit tight on room. The Nova SS is strictly for the man who wants to feel muscle when he hits the accelerator. PS

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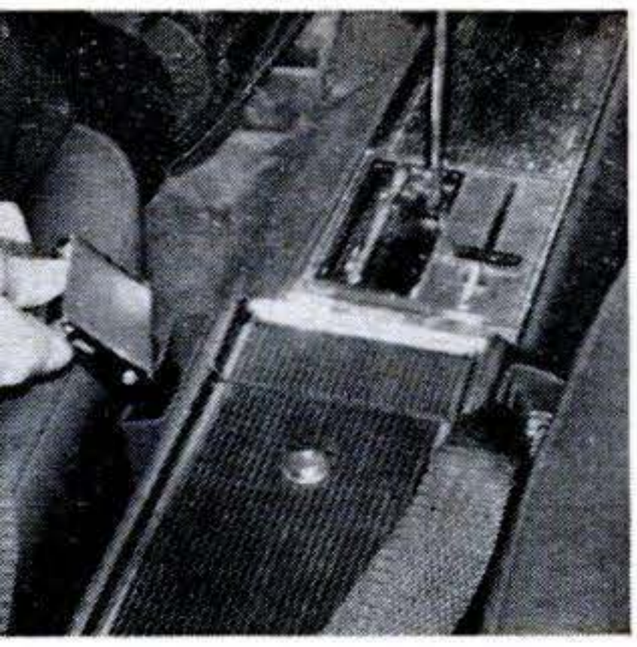
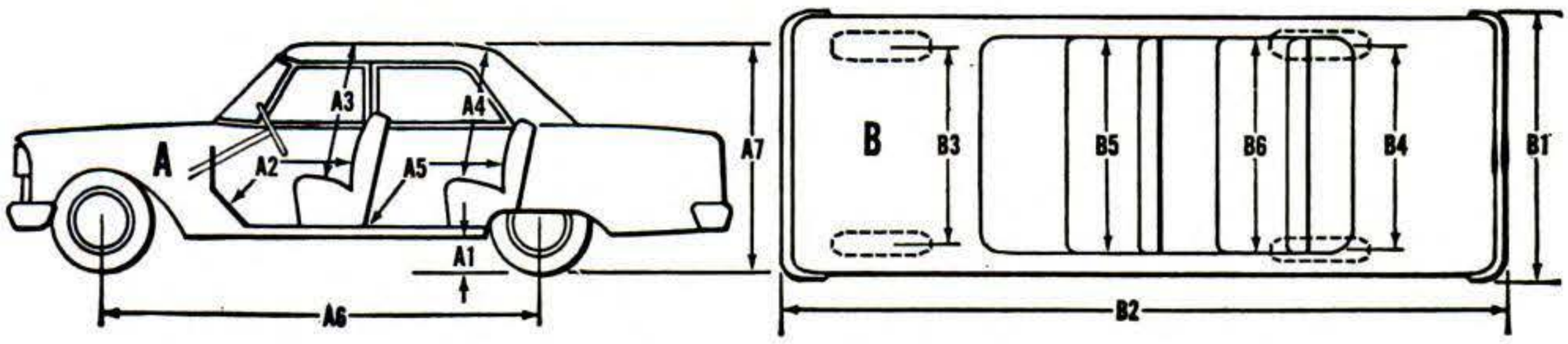


Rogue's seat belts habitually got caught between the seat and console; it was annoying to extricate and fit.

Dunne's dilemma: Chevy II seat-belt ends could not be found with the door closed. Strapped in the harness, he couldn't close the door.



DIMENSIONS (inches)		RAMBLER American Rogue	CHEVROLET Chevy II Nova SS	PLYMOUTH Valiant Signet
A1	Ground clearance	6.0	5.2	5.5
A2	Front leg room (max.)	41.0	41.0	40.8
A3	Front head room	38.2	37.2	38.4
A4	Rear head room	36.5	36.4	37.3
A5	Rear leg room (min.)	36.0	31.0	35.4
A6	Wheelbase	106.0	110.0	108.0
A7	Overall height	53.36	53.8	53.6
B1	Overall width	70.84	71.3	71.1
B2	Overall length	181.0	183.0	188.4
B3	Front track	56.0	56.8	57.4
B4	Rear track	55.0	56.3	55.6
B5	Front hip room	57.2	59.2	57.1
B6	Rear hip room	56.38	58.6	57.0
SPECIFICATIONS				
Engine type		OHV V-8	OHV V-8	OHV Six
Bore & stroke		3.75 x 3.28 in.	4.00 x 3.25 in.	3.40 x 4.125 in.
Displacement		290 cu. in.	327 cu. in.	225 cu. in.
Compression ratio		9:1	10.25:1	8.4:1
Carburetion		Single 2-bbl.	Single 4-bbl.	Single 1-bbl.
Power @ r.p.m.		200 @ 4,600	275 @ 4,800	145 @ 4,000
Torque @ r.p.m.		285 @ 2,800	355 @ 3,200	215 @ 2,400
Transmission		Flash-O-Matic 3-speed	Powerglide 2-speed	TorqueFlite 3-speed
Axle ratio		3.15:1	3.36:1	2.93:1
Tires		Firestone	Uniroyal	Firestone
Tire size		7.35 x 14	6.95 x 14	6.50 x 13
Steering ratio (overall)		21.1:1	25.4:1	18.19:1
Turns, lock to lock		4.4	4.5	3.5
Turning diameter		36 ft.	38.4 ft.	37.8 ft.
Brakes		All drums	All drums	All drums
Brake-swept area		267.07	265.6	254.5
Curb weight		3,072 lb.	3,186 lb.	2,922 lb.
Basic price		$2,372	$2,593	$2,308
Price as tested		$2,782	$3,262	$2,627

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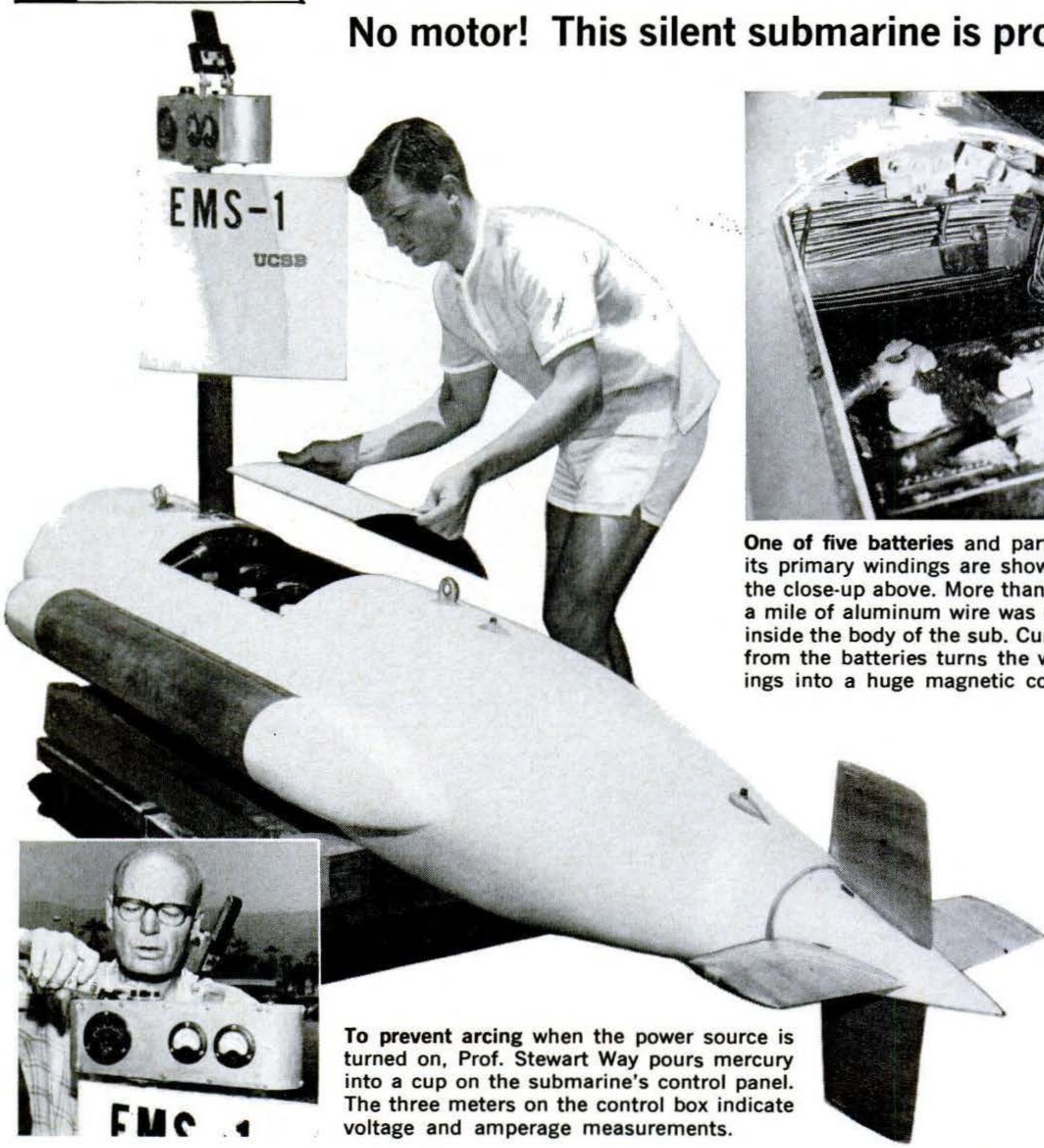
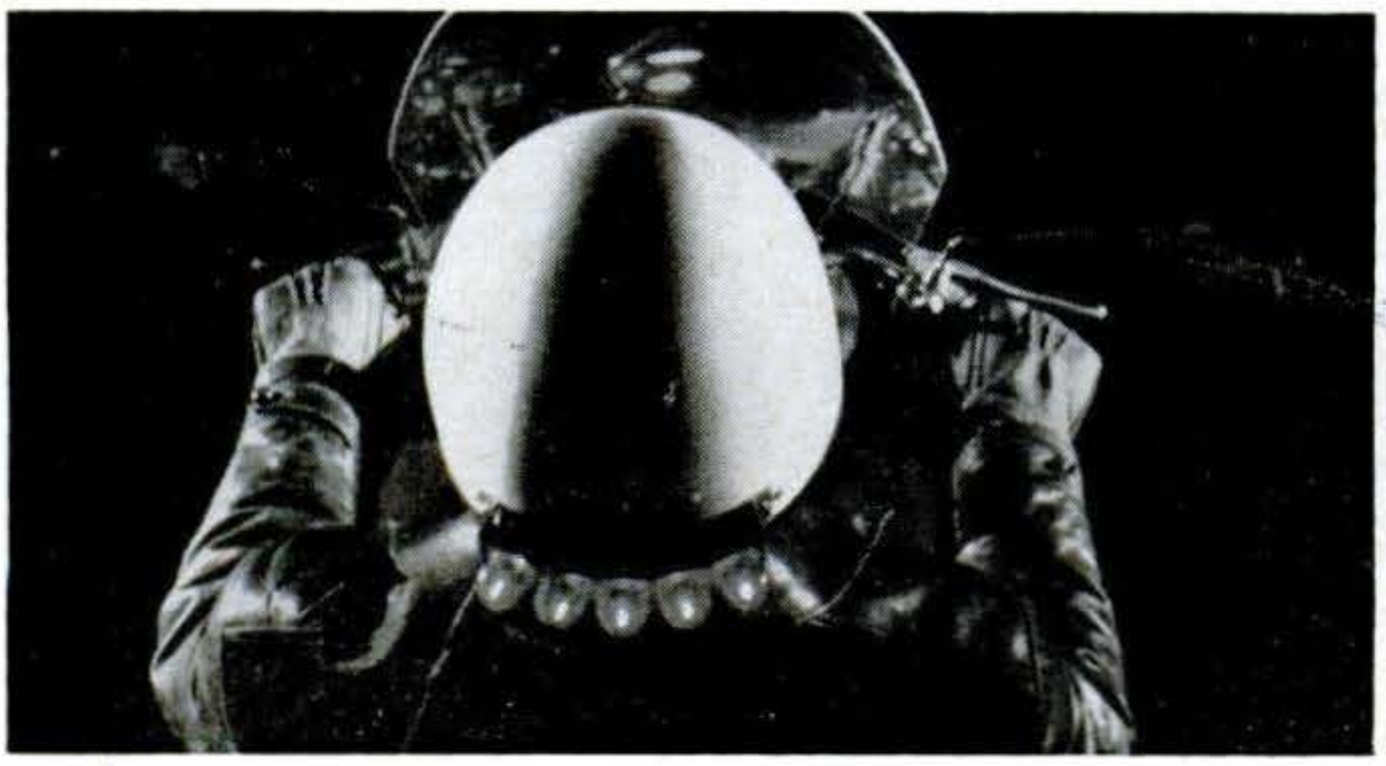
No motor! This silent submarine is propel



One of five batteries and parts of its primary windings are shown in the close-up above. More than half a mile of aluminum wire was used inside the body of the sub. Current from the batteries turns the windings into a huge magnetic coil.

To prevent arcing when the power source is turned on, Prof. Stewart Way pours mercury into a cup on the submarine's control panel. The three meters on the control box indicate voltage and amperage measurements.



Motorcyclist's helmet has built-in directional signals

What looks like the headgear of a spaceman at left is actually a new helmet for motorcyclists introduced by General Electric. The small lights at the base of the neck are a row of sequential directional signals operated by a thumb switch on a handle grip. The connections are of the quick-break type for convenience of the rider when leaving the motorcycle.

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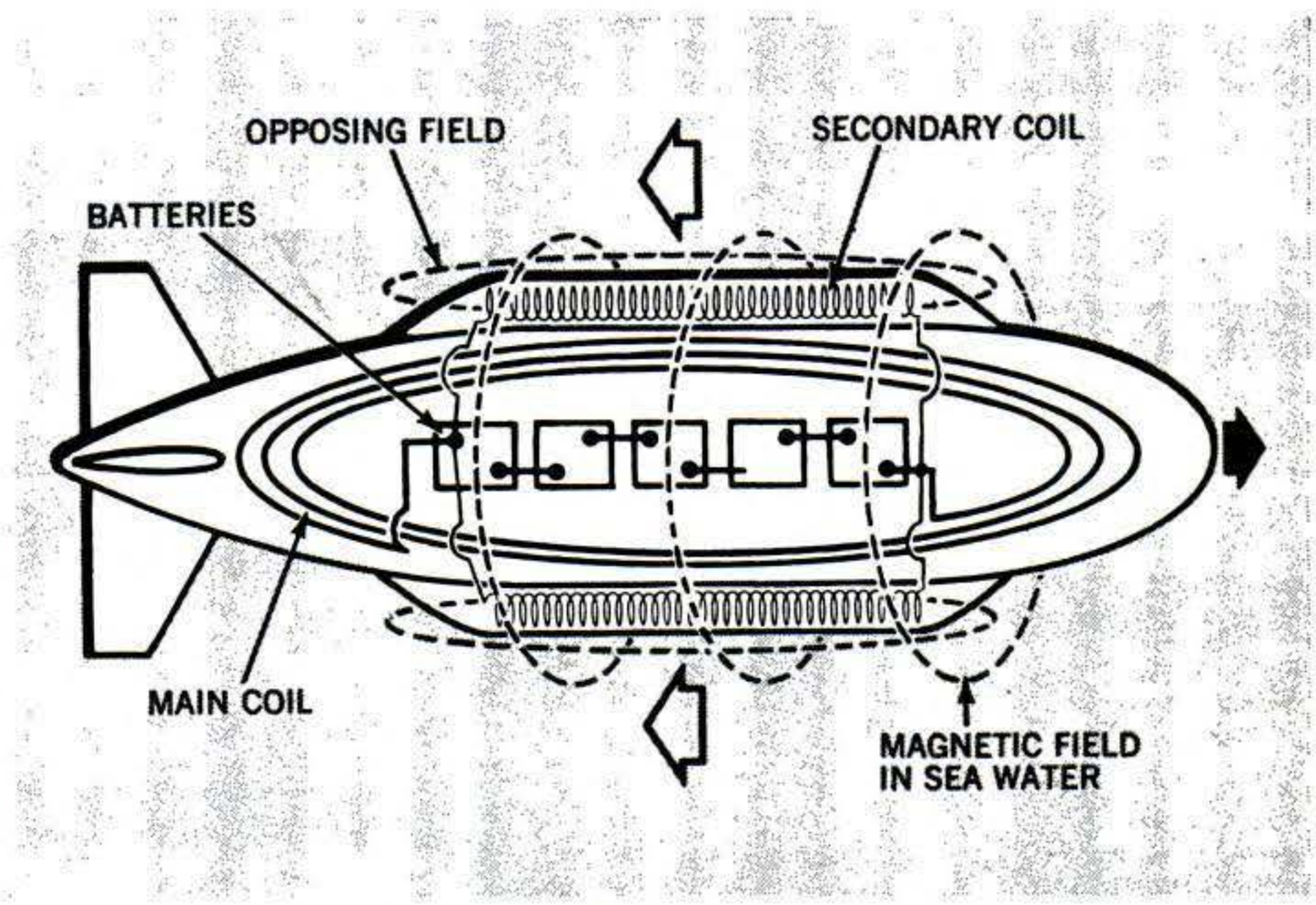
magnetism

Imagine a 100,000-ton cargo submarine cruising underwater at 20 knots. Impossible? Perhaps not. The 900-pound EMS-1 (shown at left) may be a forerunner of such a vessel. Submerged, it cruises without propellers, jets, wings, pumps, motors, or fuel. It propels itself by creating an electromagnetic field in salt water, traveling silently and without visible means of propulsion. It is barely 10 feet long, and has a top speed of two m.p.h.

The EMS-1 was built by Prof. Stewart Way and eight of his students at the University of California, Santa Barbara, to test the Lorentz Theory of Electromagnetic Propulsion. They made their sub out of a ⅜-inch oil-well casing with two ends formed of fiberglass.

Two cylinders are mounted on each side. These are lined with copper wire to form a magnetic field opposing the field formed by the large primary coil inside the sub (see diagram). The windings in the interior of the submarine form a huge magnetic coil. The windings in the side pods create a perpendicular magnetic field. The resulting Lorentz Force propels the water to the rear of the submarine, driving the craft forward. The water acts like the armature of a DC motor.

EMS-1 is "paced" by students and Professor Way as it cruises through waters of Santa Barbara Bay. The torpedo-shaped sub hit a top speed of two m.p.h.



How does it work? Lorentz principle propels the electromagnetic submarine. Opposing magnetic fields make the sea water act like the armature of an electric motor, propelling the sub forward.

Moon vehicle may be a big wheel in space

Tests of this 21-foot lunar buggy at the Aberdeen Proving Grounds, Md., may lead to a modified version that may one day roll on the moon. The MTA (Mobility Test Article) was designed by GM to climb seven-foot obstacles and span crevices of the same width. It weighs about 1,500 pounds and is just over 10 feet wide. Top speed is 10 m.p.h.; cruising speed, five m.p.h.

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Lunar-voyage plans call for Rocketing

To get back safely from an aborted mission, our Apollo astronauts will fall or orbit away from trouble between the earth and the moon

By DR. WERNHER VON BRAUN
Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.

A manned voyage to the moon is a pioneering project of unprecedented dimensions—in the distance it will take man from the earth, in the rocket power it will require, and in the complexity of its techniques and space maneuvers.

Many things can go wrong, during preparations and on the way. Those mishaps and equipment failures must not be as catastrophic as the flash fire in which three brave and dedicated astronauts lost their lives two months ago—a disaster during a pad-checkout test of the first manned Apollo spacecraft, after an uninterrupted string of successful ground tests and flights with all our Mercury and Gemini craft. A thorough and critical reappraisal of fire hazards and ways to reduce them, under way at this writing, should prevent a recurrence of such a tragedy.

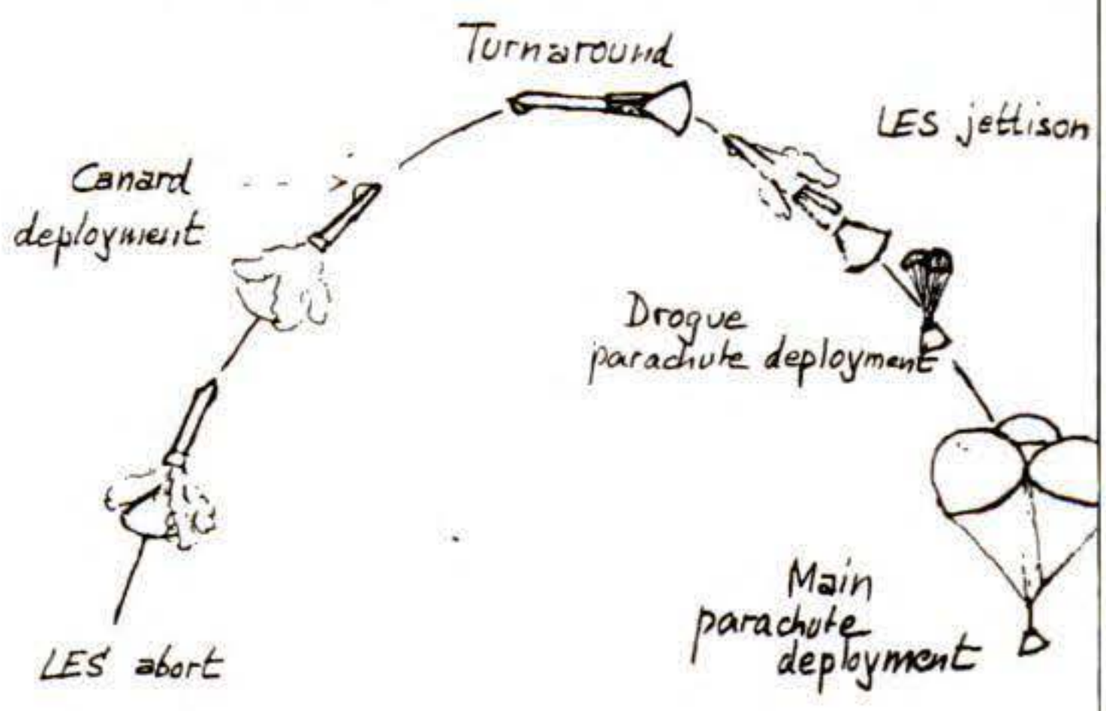
But there are other potentially hazardous situations, requiring equally serious attention, that may confront the astronauts after an actual moon voyage begins.

From the outset, a ground rule of our Apollo program has been that, even if the aim of a lunar landing has to be abandoned during any flight, chances for the crew's safe return to earth must remain high.

Hence our moon-voyage plans provide a succession of appropriate "abort" procedures for getting out of critical situations during launching, on the way to the moon, and later. The crew's best course of emergency action will change continuously, as rocket stages and spacecraft modules are successively discarded.

In case of a false start. Through the entire 140-second burn of Saturn V's first stage, the Command Module carrying the three astronauts can be hurled a safe distance away from a faltering launch rocket and parachuted into the sea.

The way back to earth is via LES, the Launch Escape System—a solid-propellant



rocket mounted on a tower atop the spacecraft, and triggered automatically or by the crew, depending on the kind of emergency. As it fires, the Command Module separates from the Service Module. What happens next is shown in my sketch above:

At the high-g escape rocket's burnout, "canard" fins at the tip of the tower are deployed, and aerodynamic forces on them swing the tower into the wake of the Command Module. At 25,000-foot altitude the tower is jettisoned, and drogue parachutes unfurl. At 12,000 feet the main chutes open and lower the Command Module for a safe splash. From an abort toward the end of the first-stage burn, the astronauts will land in the ocean about 400 nautical miles downrange from Cape Kennedy.

If all goes well during the first-stage burn, the LES will be jettisoned soon after Saturn V's second stage takes over.

Then, for the early part of the second

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ut of Emergencies

stage's six-minute burn, the available abort procedure is "sub-orbital free fall":

The combined Command and Service Module (CSM) separates from the launch vehicle and a 10-second burn of the Service Module engine adds distance. Then the Command Module, separating from the Service Module, turns around and reenters the denser atmosphere with its blunt heat shield forward. A free-fall abort as late as feasible, three minutes after ignition of the second stage, would land the crew in the Atlantic about 3,200 nautical miles downrange of the Cape and just short of the African coast. This abort procedure can be modified, by a second Service Module burn, to maneuver the splashdown point closer to a recovery ship and thus shorten the waiting time for the ship's arrival.

Uphill into orbit. Should trouble strike after the second-stage burn is half through, "uphill" abort into parking orbit is the answer. The balky second stage will be dropped and the third stage fired up. It will enable the crew to reach a low orbit where they can stay, even for days, until the time rolls around for a Gemini-style reentry and a precision splashdown near a recovery ship.

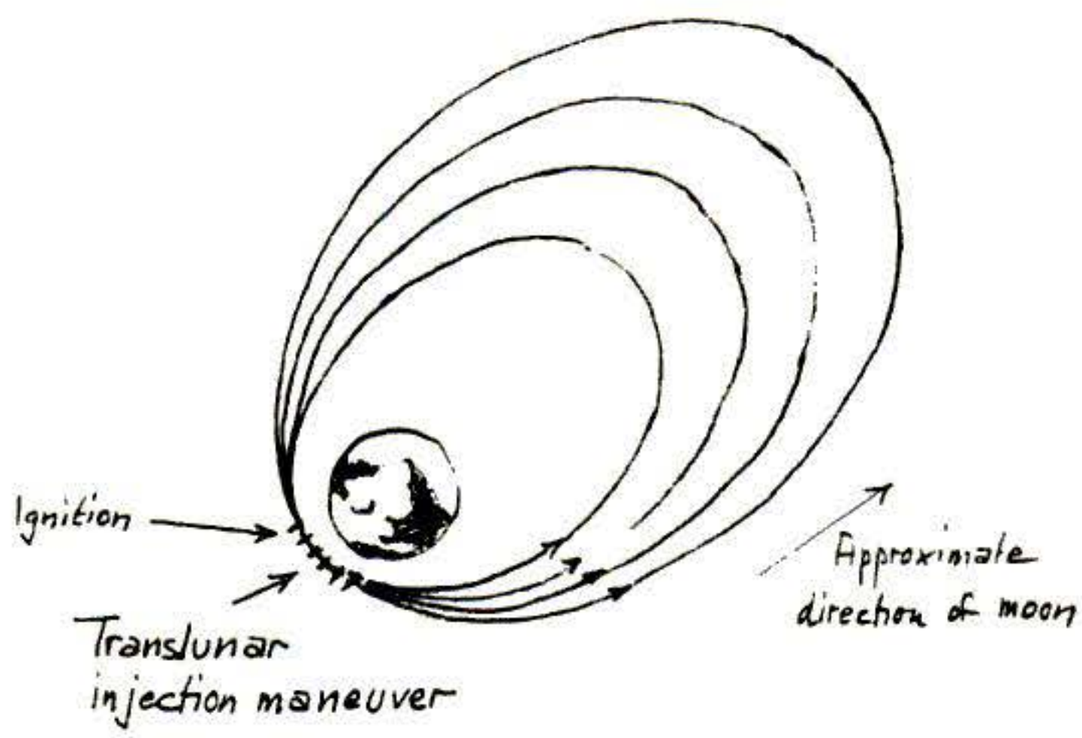
The astronauts would use the Service Module propulsion system, whose fuel reserves remain untapped, to de-orbit back into the atmosphere. In the unlikely case that it failed, they could de-orbit with the Saturn's third stage. Or, after docking the Command Module to the Lunar Module and extracting the latter from the Saturn, they could fire the LM's descent engine.

After a normal ascent into the planned Apollo parking orbit, the astronauts can descend the same way, if they discover that some faulty subsystem makes it impossible to continue the voyage to the moon.

Translunar injection. The next power maneuver of the lunar-flight plan is translunar injection—the second burn of Saturn V's third stage, to drive the spacecraft from its earth-circling parking orbit into a trajectory toward the moon. Should the third stage fail during this power maneuver, the astronauts would turn off its engine, and separate their spacecraft from the balky rocket stage. Then they would use the Service Module engine to drive themselves back into the atmosphere.

My sketch below shows the family of gradually widening elliptical orbits in which they could wind up, if the 340-second power maneuver for translunar injection ended too soon. If a premature cutoff occurs early, the period of revolution in elliptical orbit will be on the order of a few hours. But if it happens shortly before we reach the speed that would take us to the moon, the period of revolution may be several hundred hours. This opens a new aspect of possible abort situations:

Are we in a hurry to get back to earth—for instance, because the spacecraft's life-support system or its electric-power equipment is acting up? Or is our predicament such that we must try to return with a minimum of fuel—perhaps because we have discovered a fuel leak? Is it safer to splash down in good weather and daylight near a recovery ship, even if this takes a little longer? Or is our emergency so pressing that we'll accept less-desirable conditions to get down sooner?



We have a wide choice, now that we are in deep space. The flight director, in consultation with the command pilot, must weigh all the factors to select the best abort procedure for a particular situation. My sketch on the following page shows the principal difference between "time-critical"

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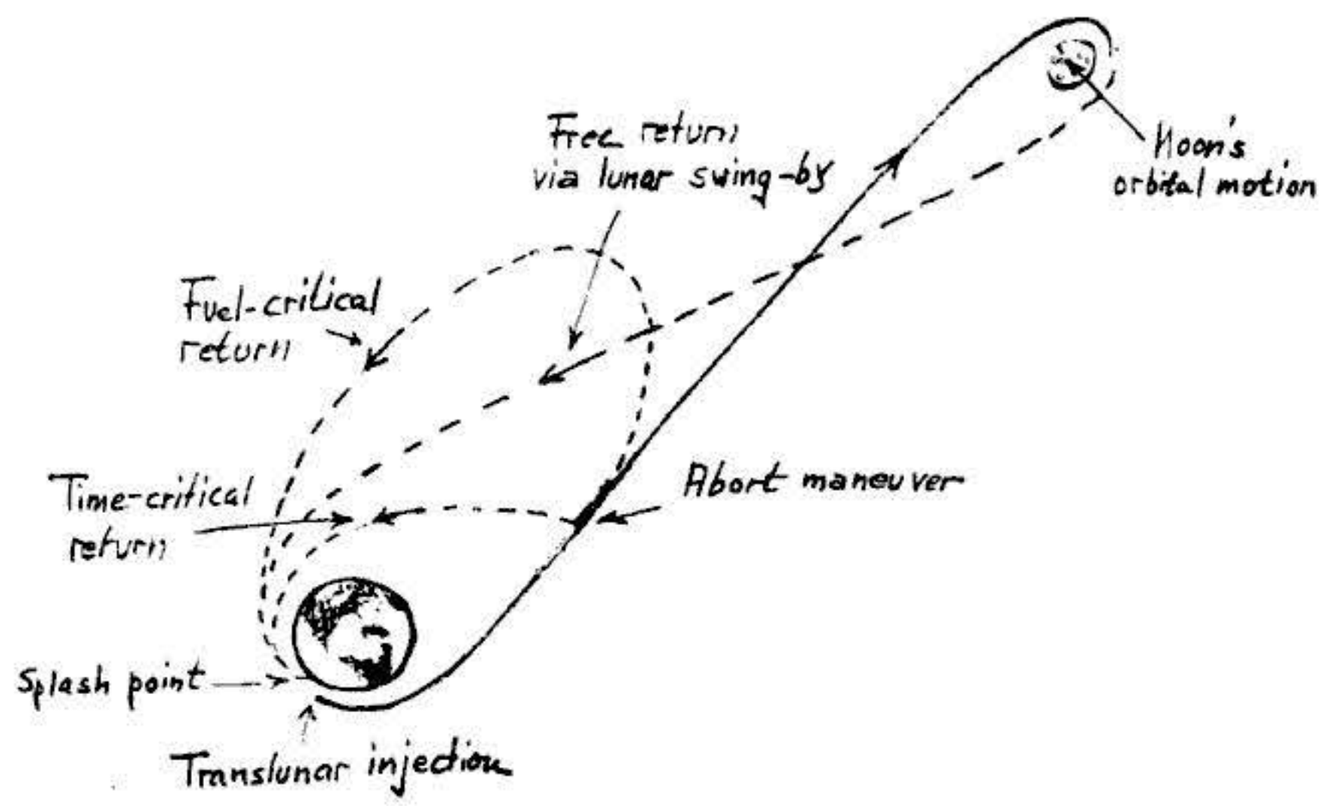
and "fuel-critical" abort maneuvers on this leg of the flight.

And this choice between fast and fuel-saving returns is still open to us, in case of trouble during the three-day unpowered coast to the moon that follows translunar injection.

"Snapping the whip" around moon. As we get closer to the moon, however, another abort option presents itself: Why not just keep going, and let the moon's gravity swing the spacecraft around and throw it back to earth? All early-Apollo flight plans are carefully designed to offer this "free-return" feature.

Free return requires one or more minor course corrections to bring the spacecraft precisely into an acceptable atmospheric-reentry corridor, and to time the arrival so as to reach a preselected landing site on the rotating earth. But there's plenty of power left for these final corrections, since no fuel has been expended to de-boost the craft into a lunar orbit and get it out again. And if our trouble deprives us of a lunar landing, a free-return swing around the moon still gives us at least a close-up look at our heavenly target.



De-boost into lunar orbit. Next in the flight plan comes the lunar-orbit injection maneuver. Using the Service Module engine as a brake, the astronauts can slow down enough to let the moon capture their spacecraft in a circumlunar orbit. If the engine failed to start, their lives would not be in serious danger. Due to the free-return feature, they'd simply sweep around the moon and be on their way home.

Premature cutoff or overburn could create some rather hairy situations for them—but, even here, carefully planned emergency procedures will give them high assurance of safe return from a mission in trouble.

If the engine started and then stopped prematurely, one possible result could be an unstable elliptical orbit around the moon, which would ultimately hurl the spacecraft out of both the moon's and the earth's gravitational fields. A premature cutoff somewhat later could put the spacecraft into an elliptical orbit with the unpleasant feature that its lowest point is below the moon's surface! Similar "impact ellipses" would result from an overburn that slowed the spacecraft down to a speed below the desired capture speed.

All these cases call for quick action by the crew. The spacecraft must be turned to an attitude in which its restarted Service Module engine will promptly restore the required direction and speed of motion. Or if that engine balks, the Lunar Module descent engine must be swiftly pressed into service to avert a crash.

Lunar landing and reascent. Almost the only element in the entire lunar-flight plan where the crew's survival depends on flawless operation of nearly all systems is the LM, the Lunar Module. In it, two of the three astronauts will descend from lunar orbit to the moon's surface, and return to the Command and Service Module left circling in orbit. In the unlikely event that they are forced to abandon the landing attempt a few hundred feet above the lunar surface, they must come back at once to the CSM.

Descent of the LM to the lunar surface and return to the CSM is possible only if all vital parts of the LM work well. This is an accepted risk in the Apollo program. Since the CSM cannot land on the moon, all abort procedures for the landing party must aim at a successful rendezvous with the CSM. It is the only way to get home.

Returning to earth. After the lunar landing party has reboarded the Command Module, the CSM is on its own. Gone is the backup for a balky Service Module that the LM propulsion system provided before. For the return to earth, therefore, abort procedures no longer exist—but the planned flight back has just the same purpose, safe return of the crew. The only difference is that a normal return ends a completely successful mission. PS

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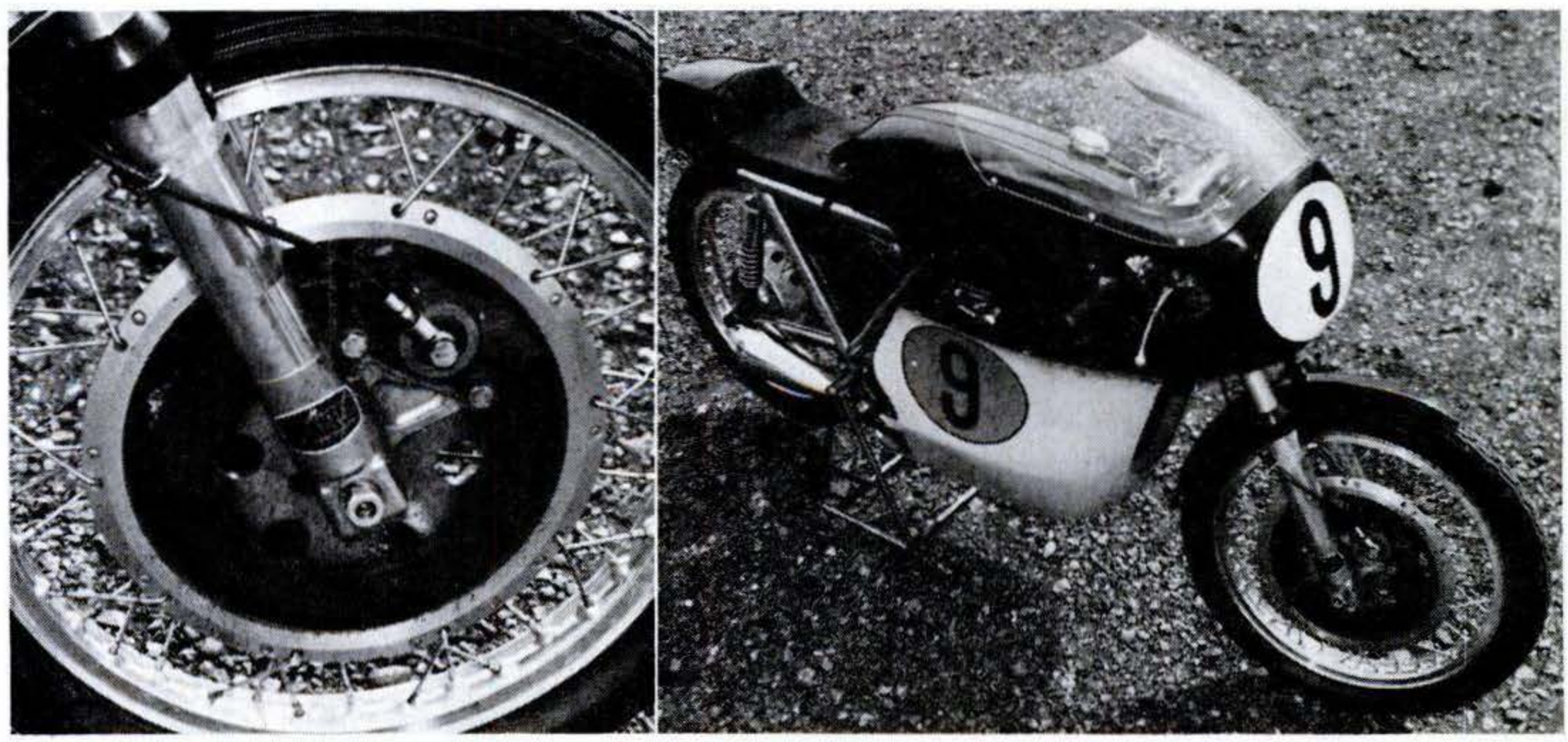
Florida Sportscraft is a boat (above), and when loaded onto its trailer (below) becomes a land camper.

Land camper turns into a fishing boat

Masel Huston of Venice, Fla., builds this amphibious vehicle for both land and water travel. Called the Florida Sportscraft Mark III, it has twin fiberglass hulls as in a catamaran; they are molded in lapstrake fashion. It is 16 feet long, has a 7½-foot beam, and can accommodate any size engine from 20 to 100 hp. As a boat, the Sportscraft weighs 850 pounds without the engine. A 580-pound trailer brings its camper weight up to 1,430 pounds. The camper-boat is sold by Maton Fabrications, 143 E. Tampa Ave., Venice, Fla. 33595.



Disk brake for motorbikes

Fade-free stopping from high speeds is made possible by the disk brake (above, left) which is said to be the first ever put on a production motorcycle. The brake, designed for racing, is installed on a 150-m.p.h. Rickman-Metisse (right). Built by British Lockheed, the brake is hydraulically controlled through a flexible hose from a master cylinder on the handlebars.

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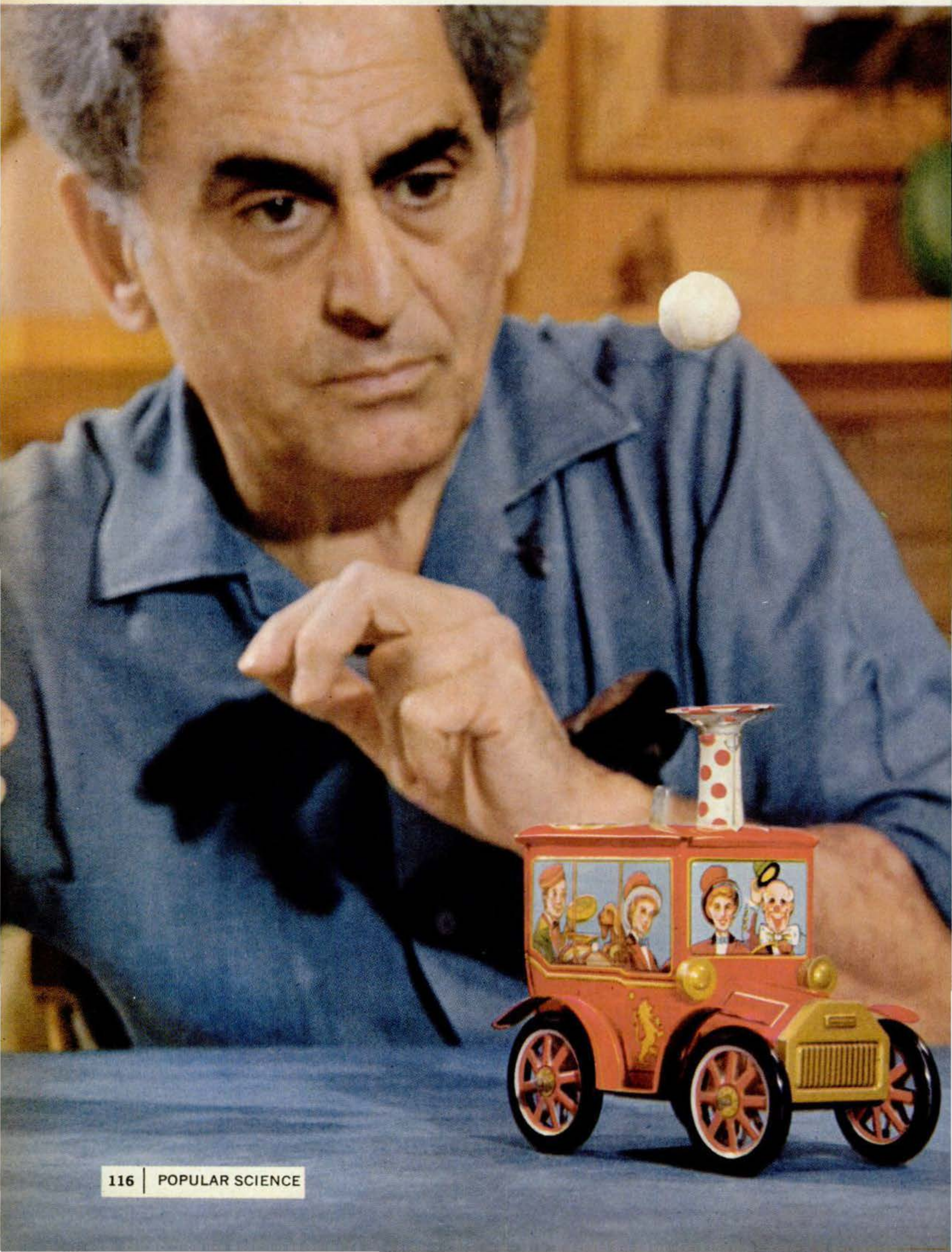
CLASSIC TOYS TEST YOUR



PHYSICS KNOW-HOW

Things are never as simple as they seem. Match your wits against Professor Miller in explaining how these toys do their tricks

By WESLEY S. GRISWOLD

PHOTOS BY RALPH POOLE

"Certain toys are far more than mere playthings," declares Prof. Julius Sumner Miller, that extraordinarily effective and renowned teacher of physics at El Camino College, Torrance, Calif., whom POPULAR SCIENCE first introduced to its readers last May. "Otherwise, in my 58th year, I would not be playing with them."

Professor Miller has obligingly consented to show you that profound physical riddles are involved in the working of these deceptively simple-looking toys. If you must refer to the answers, you'll find them on page 208.

THE CAR THAT SHOWS WHY PLANES CAN FLY

"Now, here," Professor Miller began, "is a little wind-up car with a smokestack (left and below). I place a tiny Styrofoam ball on top of the stack and release a lever. A spring unwinds and the car moves. At the same time, a stream of air blows through the stack and pushes the ball aloft and makes it spin.

" 'Well, Miller,' you're going to say, 'the air is blowing up, with a force. The weight of the ball is a force down. And when the force up equals the force down, the ball stays there.' And I'll agree with you—but watch!

"I slowly tip the car a few degrees off the vertical. Now the stream of air from the stack has two components—horizontal and vertical—and the horizontal one should blow the ball away. But it doesn't! Isn't that fantastic? Please explain it to me."

THE PROFOUND PHYSICS OF A TRIVIAL AUTO

"This trivial toy cost me 10 cents," continued the professor, picking up the small automobile shown in the photos directly below.

"What does a child do with it? He strokes its wheels a few times against the palm of one hand, or on a tabletop, and sets it down. It then runs by itself.

"And you say, 'Well, are you going to make a case for this, Miller?' And I say, 'I could write a hundred *pages* about the physics of this toy. Especially if you should happen to place it on a glass surface, and its rear wheels spun without moving it. The physics in the latter instance is *brutal*.

"But let's examine the car. First, you see, its rear wheels are geared and rubber-tired. Amidships, in the plane of the long axis of the vehicle, there's a flywheel. The flywheel has a heavy periphery—and this is important. It has, as we say in physics, a large moment of inertia.

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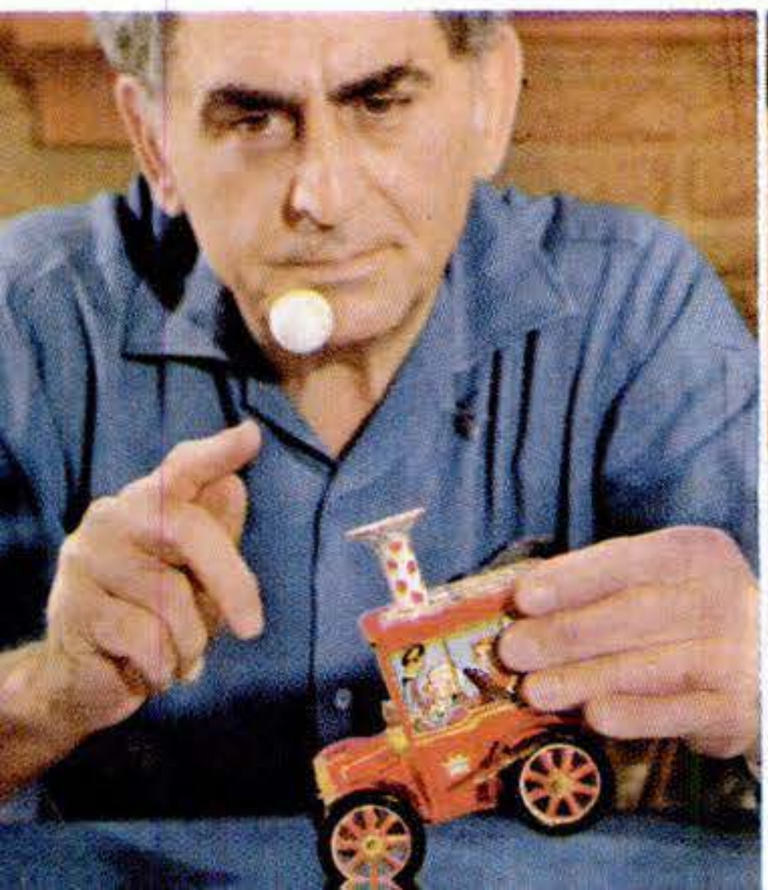
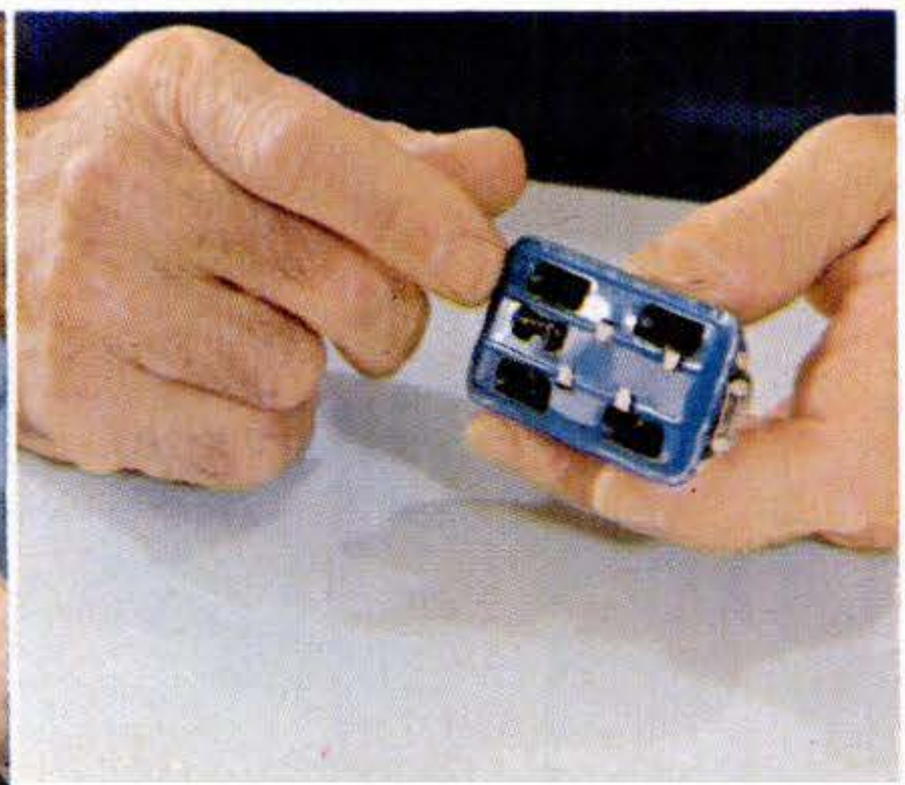
: left and below: Prof. Miller with e first toy described.

Flywheel with heavy periphery that makes this little car go is indicated by Prof. Miller (below, left). Then he lets the car run.





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"Now, can you explain to me what laws of physics enable this car to run?"

A TEDDY BEAR ON WHEELS ROLLS SELF BACK HOME

"I have here a small plastic teddy bear suspended by his outstretched arms between two wheels," said Professor Miller, extracting another toy (at top of facing page) from his store of them. "He is hinged on a rubber band, which lies a little above his center of gravity. So he stands erect because his center of gravity is below his point of support.

"I told you he is hinged on a rubber band, but I failed to remind you that rubber is only *pseudo*-elastic. Still, it's elastic enough for this purpose. And when I roll the bear forward, the rubber band twists. But *he* doesn't twist, because his mass at the center of gravity provides a torque that opposes his being twisted. Besides, the rubber band isn't elastic enough to make him somersault, which we don't want him to do.

"What concerns us is that when I roll the bear forward—he rolls back to me. Now, how is he able to do that?"

A ROLLING WHEEL IS ENABLED TO ROLL STRAIGHT UP

"You want to see something magnetic?" asked the professor. "Good! Here is a plastic wheel with a shaft through its hub, and the shaft on each end is a truncated cone—see, it's conical—and it's iron and it's magnetized. Here is a curved iron track, open at one end, and the track has a handle. I make the wheel roll around the track by moving the track back and forth horizontally [see center panel, facing page]. To be precise, by moving my hand in phase, in resonance, with the motion of the wheel, I'm storing more and more kinetic energy in the wheel.

"Notice, when the wheel goes around the open end of the track, does not the magnetic force have to provide two things? It has to overcome the weight of the vehicle itself, which would fall off, and it has to provide the centripetal force to bring the wheel around the curve and change its direction.

"Oh, you're going to say, 'There's nothing to that, Miller. It's just magnetism.' And I say, 'Why are those shafts conical?' And I'll leave you pondering that while I show you something else.

"Now, watch what happens when I suddenly turn the track to a vertical position! The wheel travels up and down it—one—two—three—four—five—si-i-x times. And it didn't fall off when it went around the open end of the track.

"Tell me how these amazing things can happen."

RUBBER PISTOL PROVES TO BE LOADED WITH PHYSICS

"I will now show you a little rubber pistol with a Ping-Pong ball for ammunition," continued the professor. "And you will find that it's a toy involving thermodynamics, acoustics, and exterior and interior ballistics. It's one more proof that these toys are not trivial.

"Well, then, you can see that the muzzle of this rubber gun [lower left photo, facing page] is open to the atmosphere. And isn't the air inside at atmospheric pressure? Right. Now I push the Ping-Pong ball into the muzzle of the gun. Have I not compressed the air in there? Right.

"So, now what do I do? I squeeze the chamber of the gun, and out pops the Ping-Pong ball. If I squeeze the chamber with a slow force, the ball comes out with a limp motion and a dull sound. But if I squeeze the chamber with a quick, impulsive force, the ball comes out briskly with a sharp pop.

"Oh, I could go on and talk about the physics of muzzle velocity and projectile motion and interior ballistics, but what I want to know right now is what makes the ball emerge from the pistol and why does the sound vary according to the way I squeeze the chamber?"

AN INSTRUCTIVE PERFORMANCE OF DANCING DEVILS

"Now," declared Prof. Miller, "I'll show you something that would have got me hanged for witchcraft in my native New England in the 17th Century.

"Here's a little box. Its bottom is cardboard, just to give it rigidity. Its superstructure is very thin lucite. Inside, there are some tiny paper figures. I call them my dancing devils.

"And I know exactly what you are going

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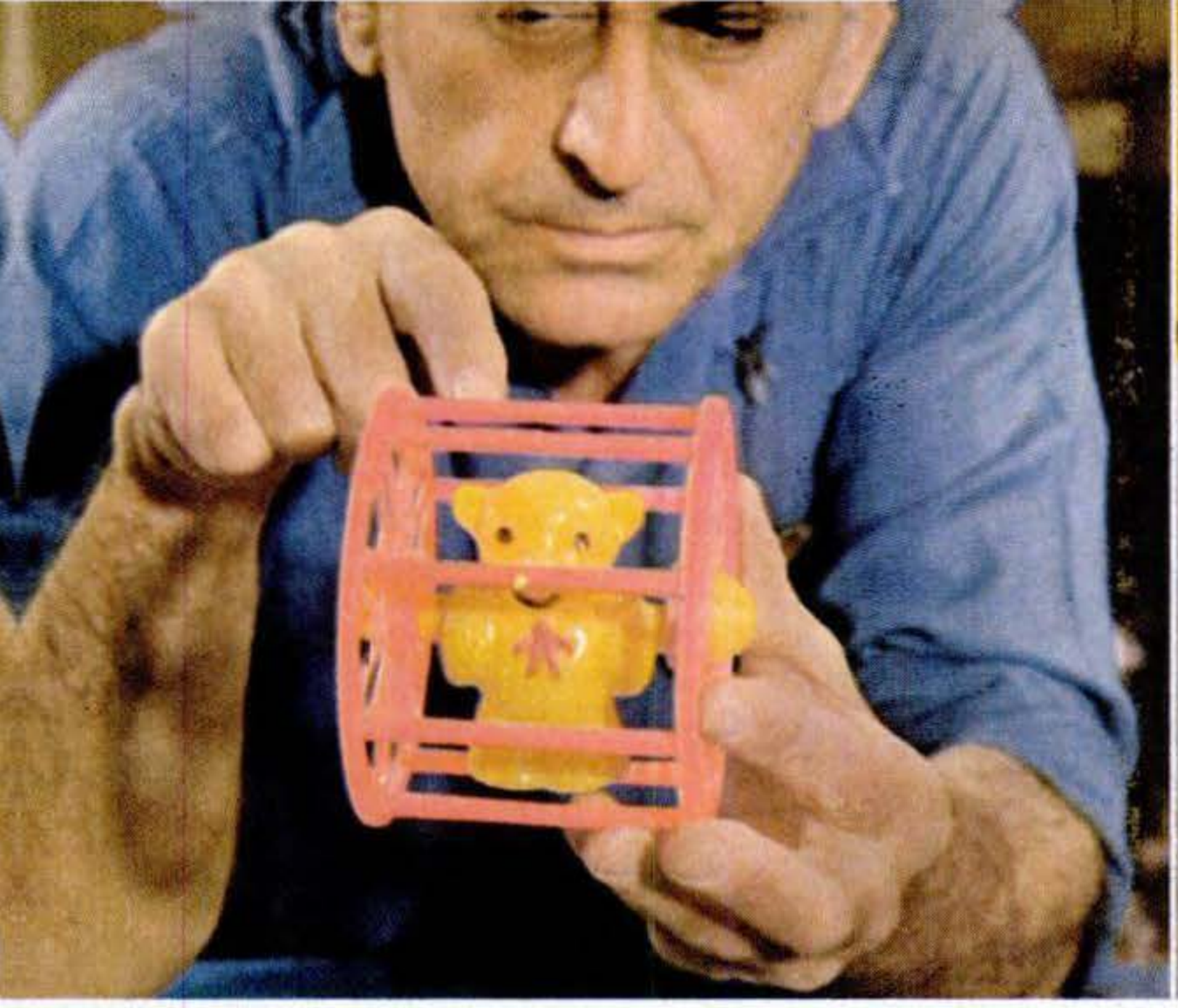
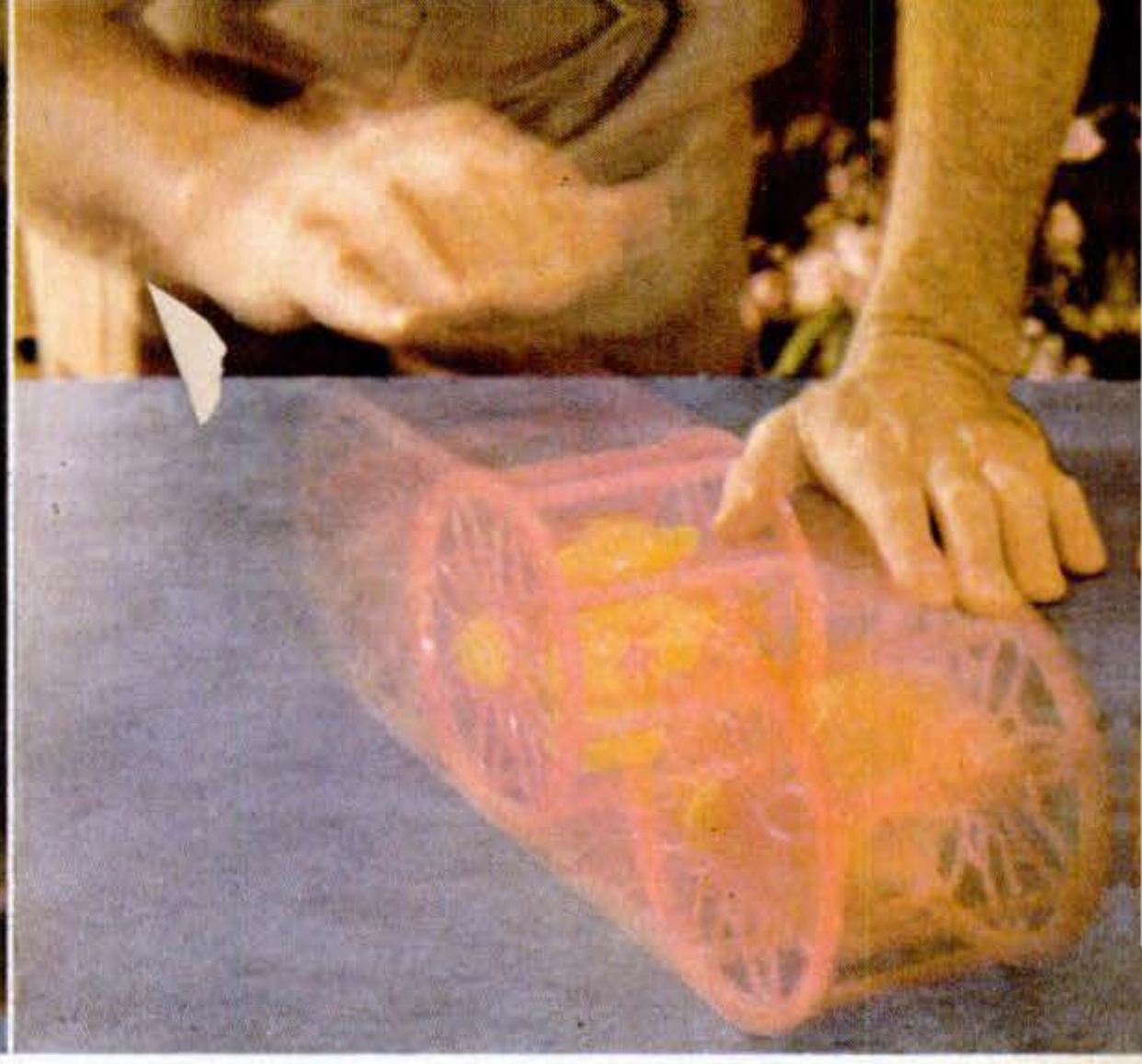
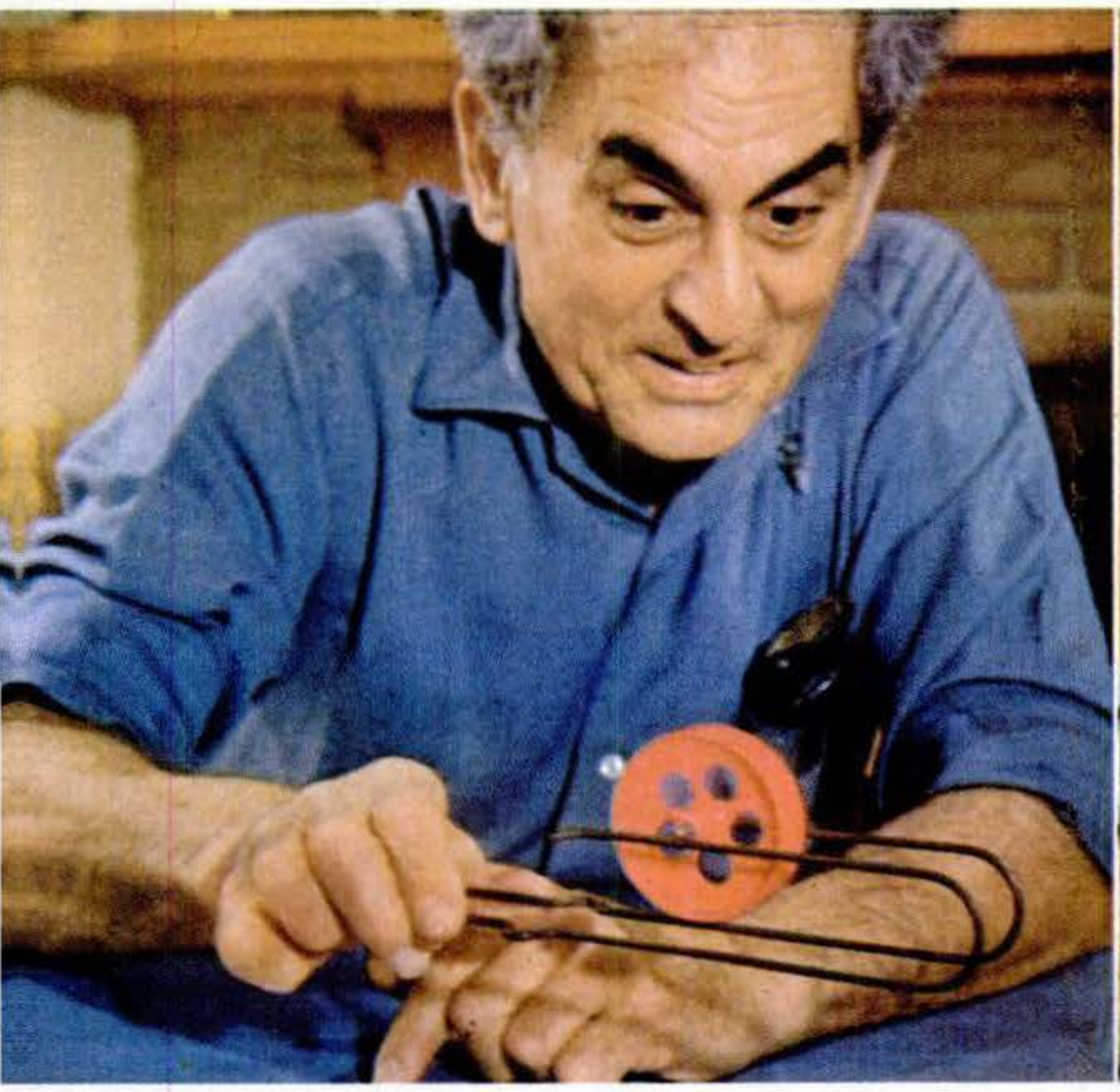
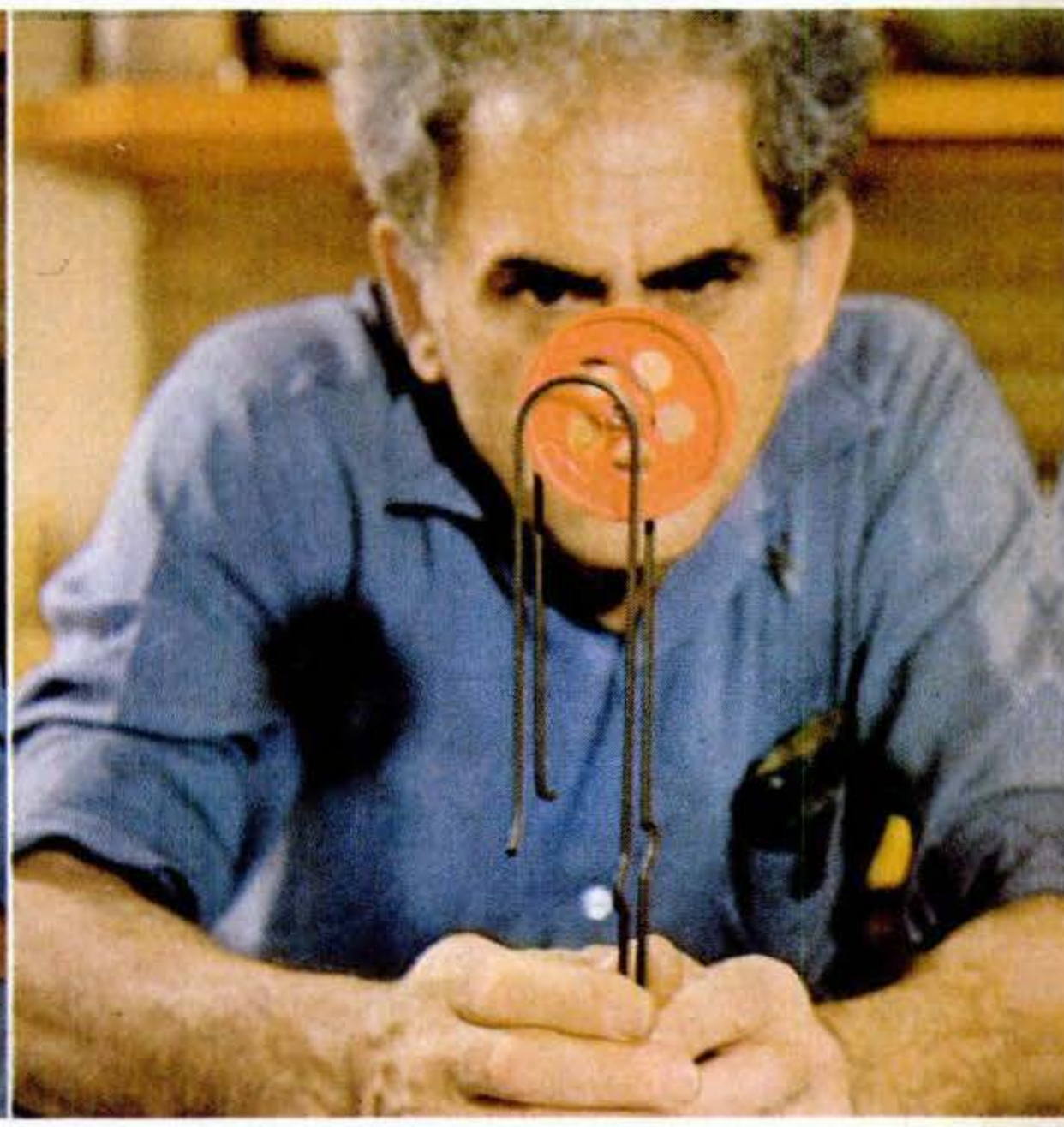




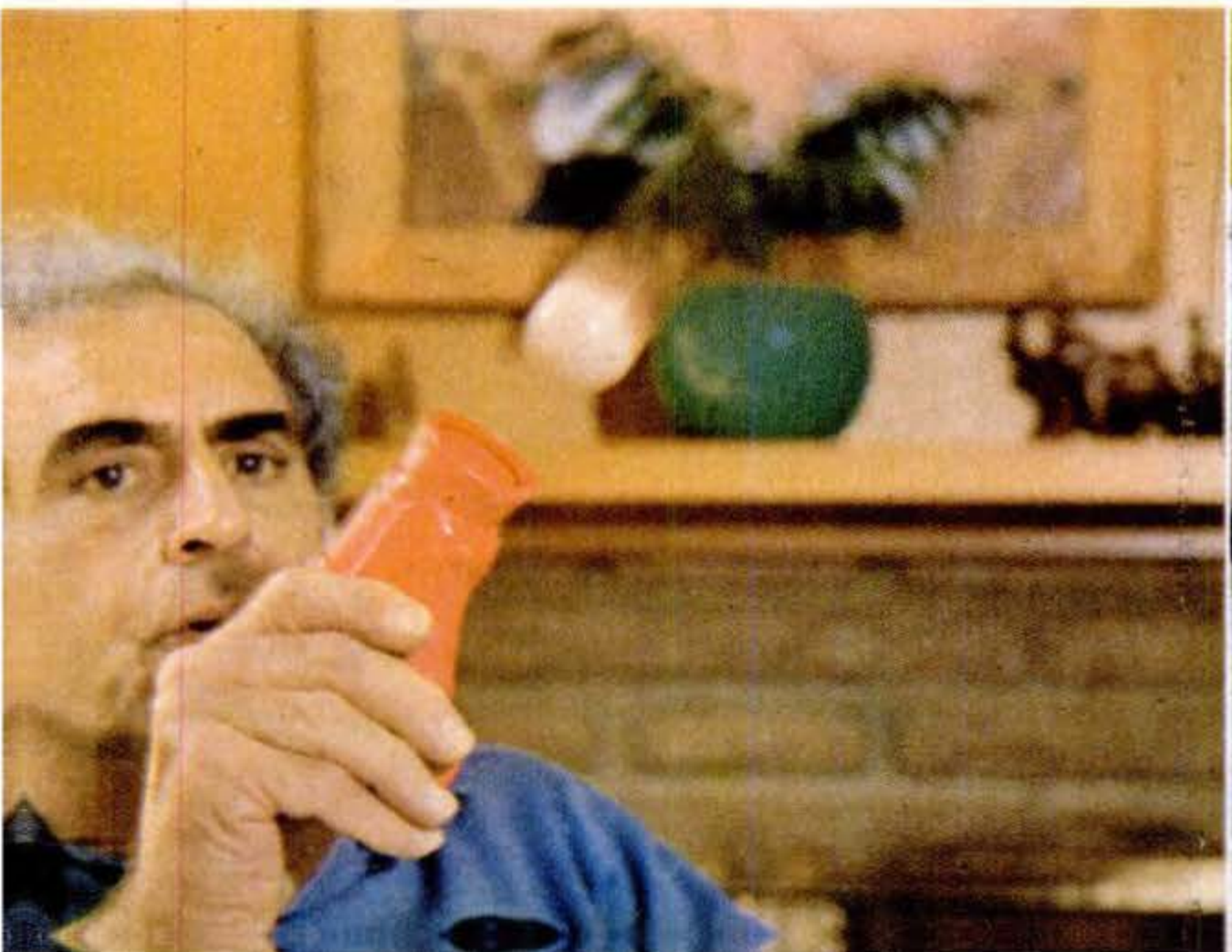
Teddy bear on wheels is shown before being pushed forward and (right) rolling back again.





Prof. Miller stores kinetic energy in a magnetized wheel and then watches it climb up vertically.

Pop goes a rubber pistol's Ping-Pong bullet!



He induces little paper devils to dance.

to say: 'what's dancing about them? I see them lying dead, lifeless, and inert.'

"But, look! I rub my fist back and forth across the top of the box [lower right-hand photo, previous page], and the paper figures leap up. Some jump to the underside of the top and cling there.

"And notice one more thing. If I put a finger on top of the box, some of the little devils jump away from my finger and cling to another part of the top.

"How do you account for this remarkable performance?"

A SIMPLE DEMONSTRATION OF JET PROPULSION

"Here is a hollow plastic chamber shaped like a dirigible," Professor Miller said as he took from a crowded box the toy shown in the photos at top left on the facing page. "It has a small hole at the rear, to which I connect a pump with a tightly fitting valve. Now I push on the pump's piston. Am I not compressing air in that chamber? Good! And this is going to be just like a jet airplane.

"But before I say one word more about this toy, I must tell you an appropriate story about a recent flight I made to Australia. I sat beside a young man with college training, and I commented to him about the marvel of jet propulsion. I remarked, just to see how he would react, 'You're agreed that the gases coming out of our jet engines are pushing against the atmosphere?'

"The young fellow said, 'Oh, yes. This thing couldn't go if it didn't have something to push against . . .' Well, you can imagine my blood pressure! So I had to give him a lecture, which was heard by all 150 passengers on the plane.

"But wait! Let's hear *your* comment on this toy. I'll release the chamber I've been compressing air in, and—*pop!*—it shoots across the room. And please note that if I had filled the chamber with water as well as air, and in appropriate proportions, I could have sent that blasted chamber 300 feet into the sky. Isn't that fantastic?

"Now, why did it go? I suppose the compressed air inside was pushing against the atmosphere in this room, and that's what made the chamber go forward. No? Good! I would have hung you from the ceiling if you had said yes.

"All right, what *did* make the chamber shoot across the room?"

A PINT-SIZE MONOCYCLIST DEFIES GRAVITY

"This diminutive German monocyclist," continued the professor, "comes equipped with a string, which you must help me hold taut, and with stiff, empty sleeves, into which I will insert two loaded sticks.

"First consider what would happen if I set him on top of the taut string without attaching the sticks to him. He would certainly tip over. Why? Because his center of gravity is above his point of support, which is where the string engages the grooved wheel he rides on. Furthermore, it's easy for him to tip about the string as an axis because his moment of inertia with respect to that axis is so small. Remember 'moment of inertia'? It means mass distribution with respect to the axis of rotation.

"Right! So I now slip one of these long, loaded sticks into each of his empty sleeves, and set him on the string.

"Look! [See photo at top right, facing page.] He rides down the string like a trooper! Why?"

THIS WALKING DOG KNOWS WHEN TO STOP

"Here's another mechanical toy—a small dog—of profound implication for beginners," Professor Miller concluded.

"Yes, it's Pluto, and his legs are hinged at the shoulders, and they are free to move in the plane of the long axis of the dog. One front leg and one back leg move together on each side, so he moves with a wobble motion. (I'm having difficulty writing the mathematics of that wobble motion. Doesn't that show you that the physics of this toy is rough?)

"Now, what do I do? You see I have a string attached to his nose [photos at bottom of facing page], and at the end of the string I have a few paper clips. So I have a force—a weight—attached to the string. I now set the dog on the table top at some distance from the edge and start him moving toward it.

"He wobbles toward the edge. But, just when you'd expect him to fall over it, he stops. Why does he stop at the brink?"

For answers to Professor Miller's questions see page 208

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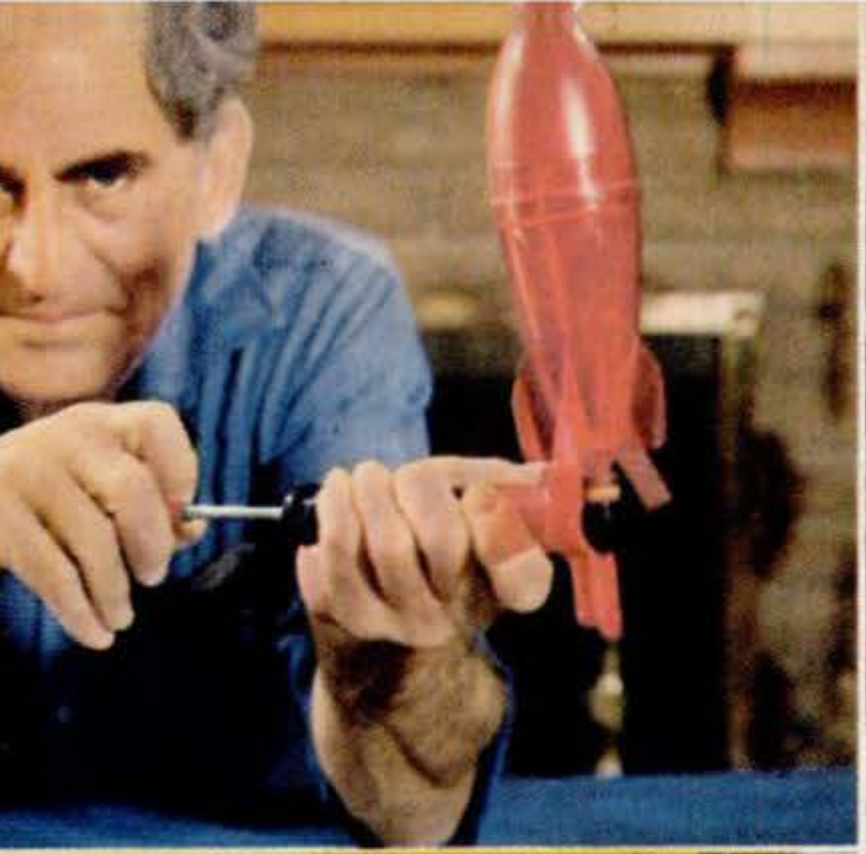
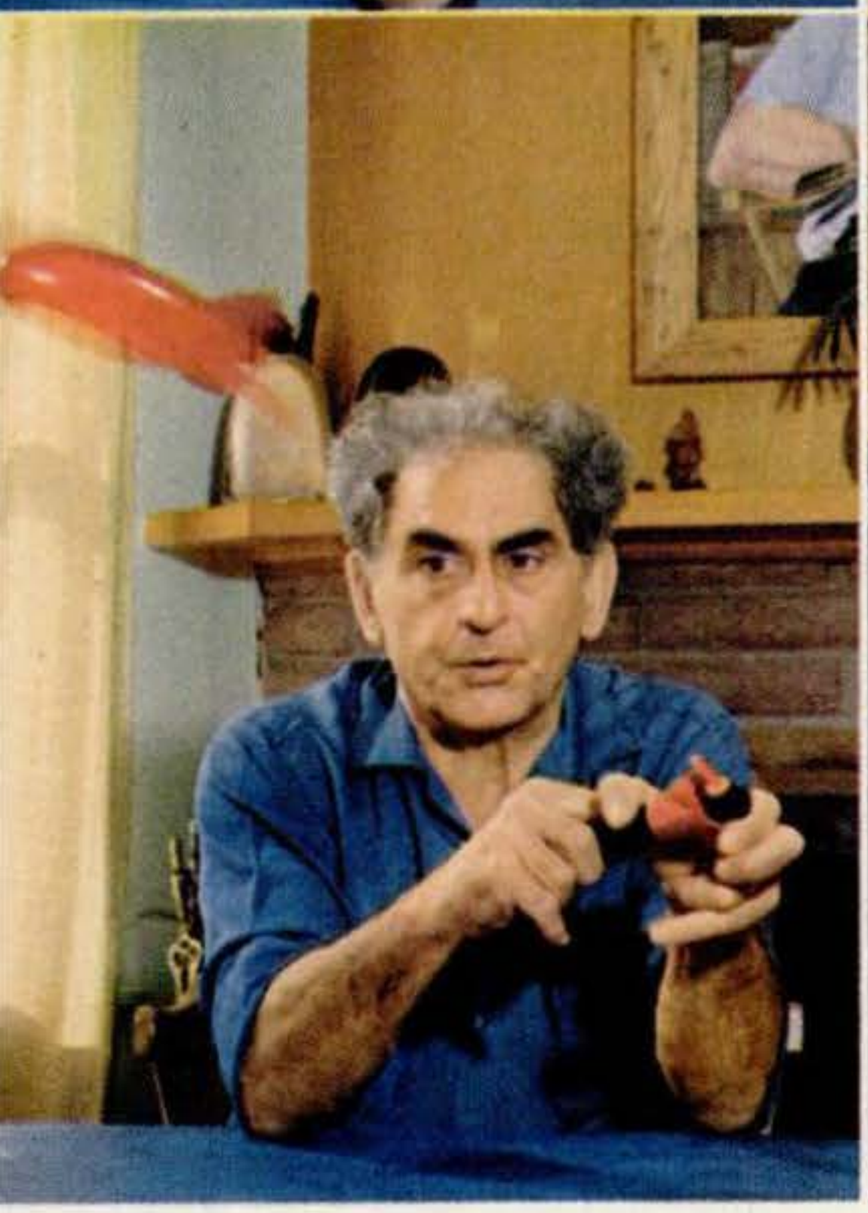
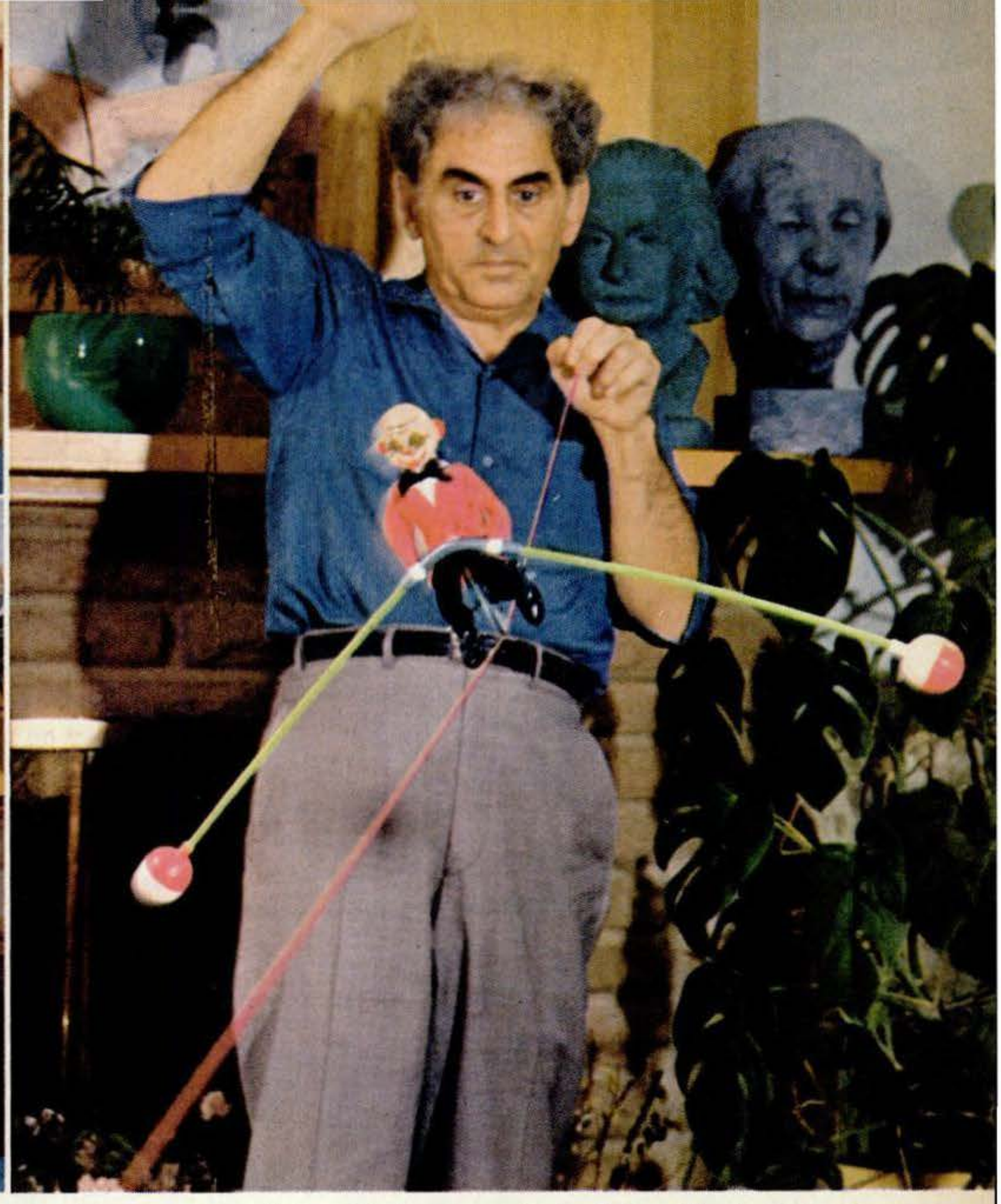
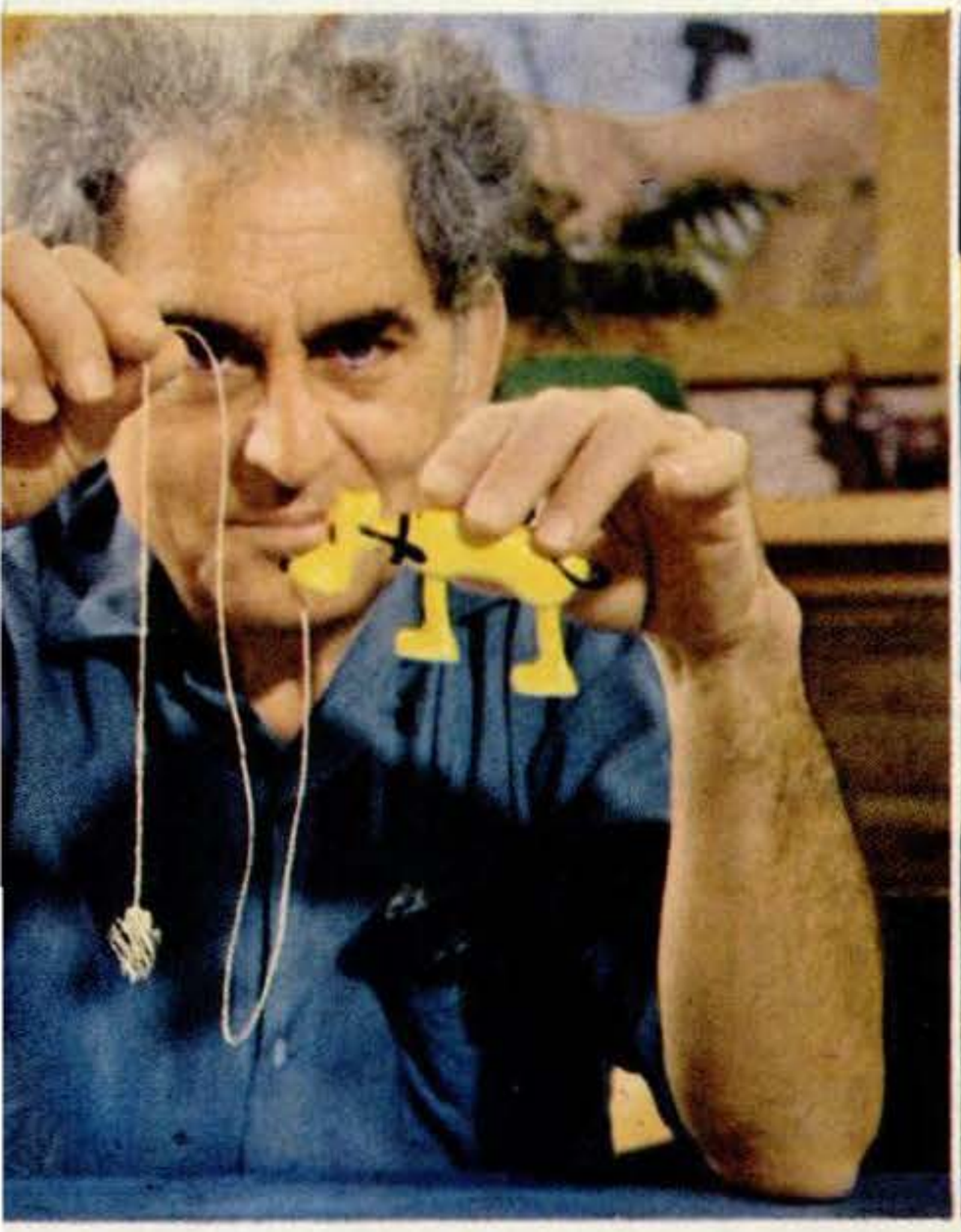


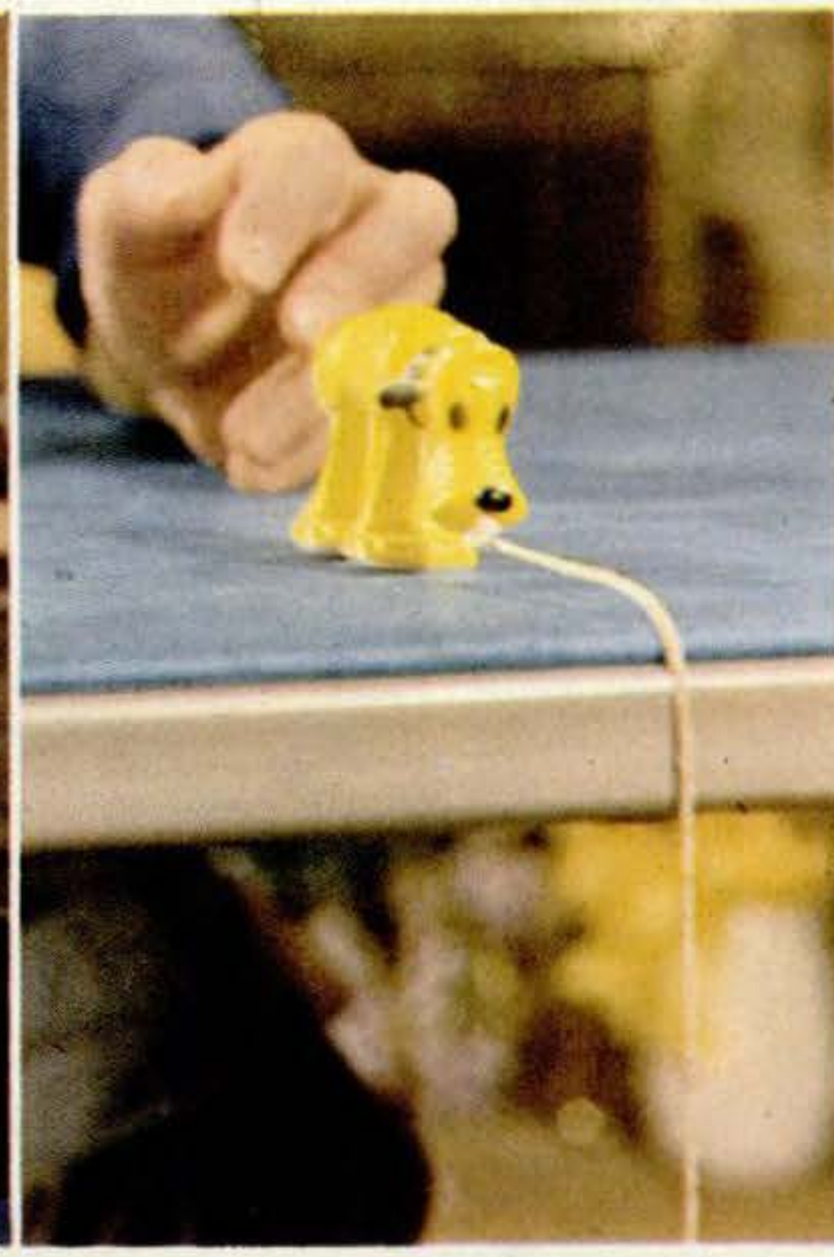


How jet propulsion works is demonstrated above by the professor.



Toy monocyclist, with heavy-ended sticks attached to his arms, rides down a long, taut string without taking a fall.





Here's the wobbling Pluto that waddles to the very brink of disaster but stops just in time.

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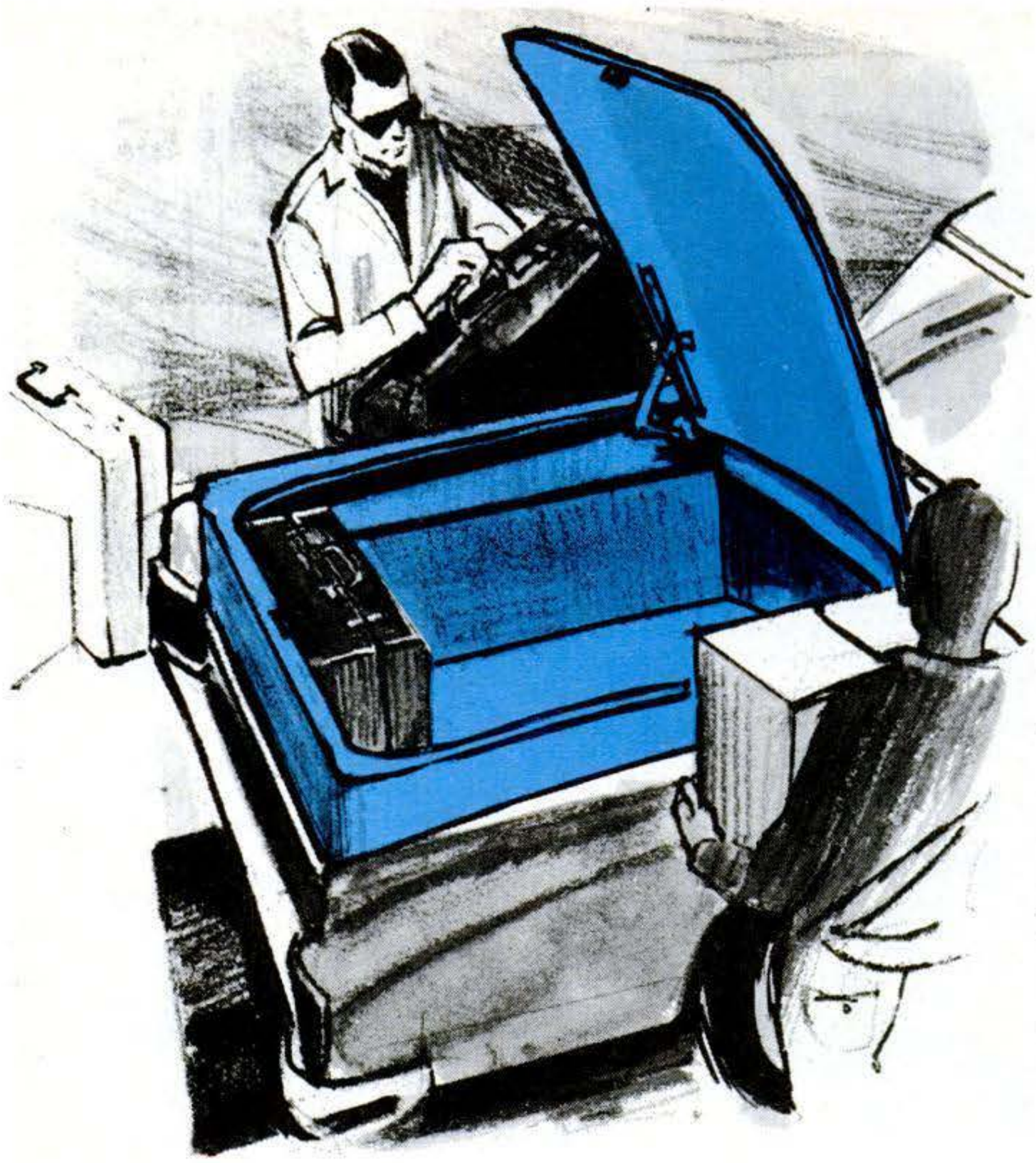
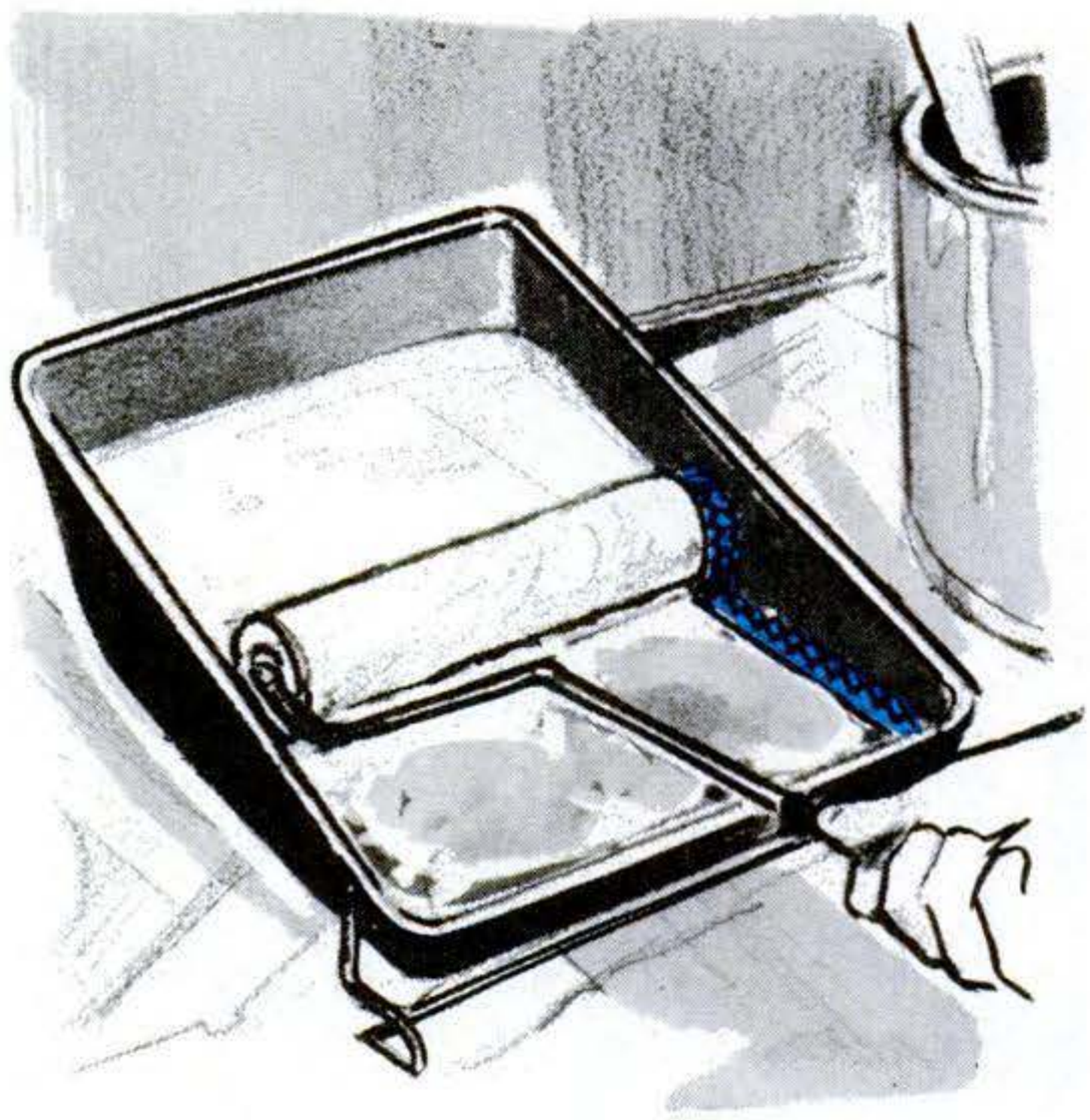
New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMORE



Trunk lifts for extra loads. A telescoping inner body in this recently patented car trunk could be raised, when needed, to accommodate extra or odd-shaped cargo. Retracted, it would not change the appearance of the car. Weather-tight seals in the expansion channels would keep the trunk dry, and the locking lid would prevent pilferage. Screw mechanisms, operated manually or by power, would raise and lower the section.

Hand truck lifts that load. A jack-raised platform built into this hand truck would allow one man to lift and load heavy items, wheel them from point to point in the usual way, and then unload and stack them without help. A conventional ratchet-type jack mechanism, engaging a toothed rack bar, would lift or lower an upper, movable platform. The rack bar would also reinforce the truck and stabilize the load.



Gear prevents roller slip. Your paint roller couldn't slide over slick paint or load up unevenly if it were geared like this one to insure uniform, no-pressure turning. A spur gear, of smaller diameter than the roller, and attached to the end of the core, would engage a gear rack set into the tray. Meshing teeth would insure that the lamb's wool would always turn evenly as it was moved in and out of the paint.

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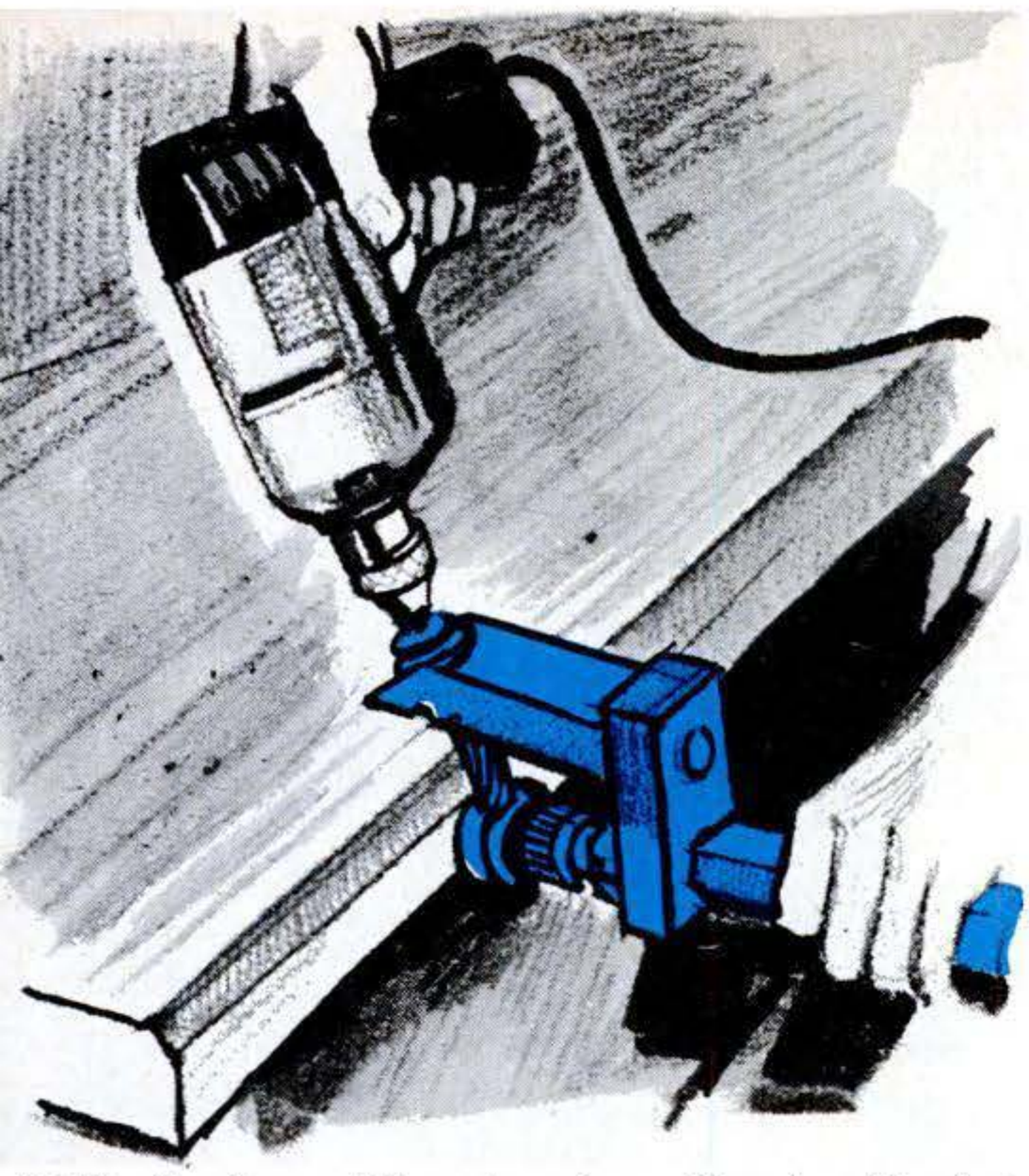
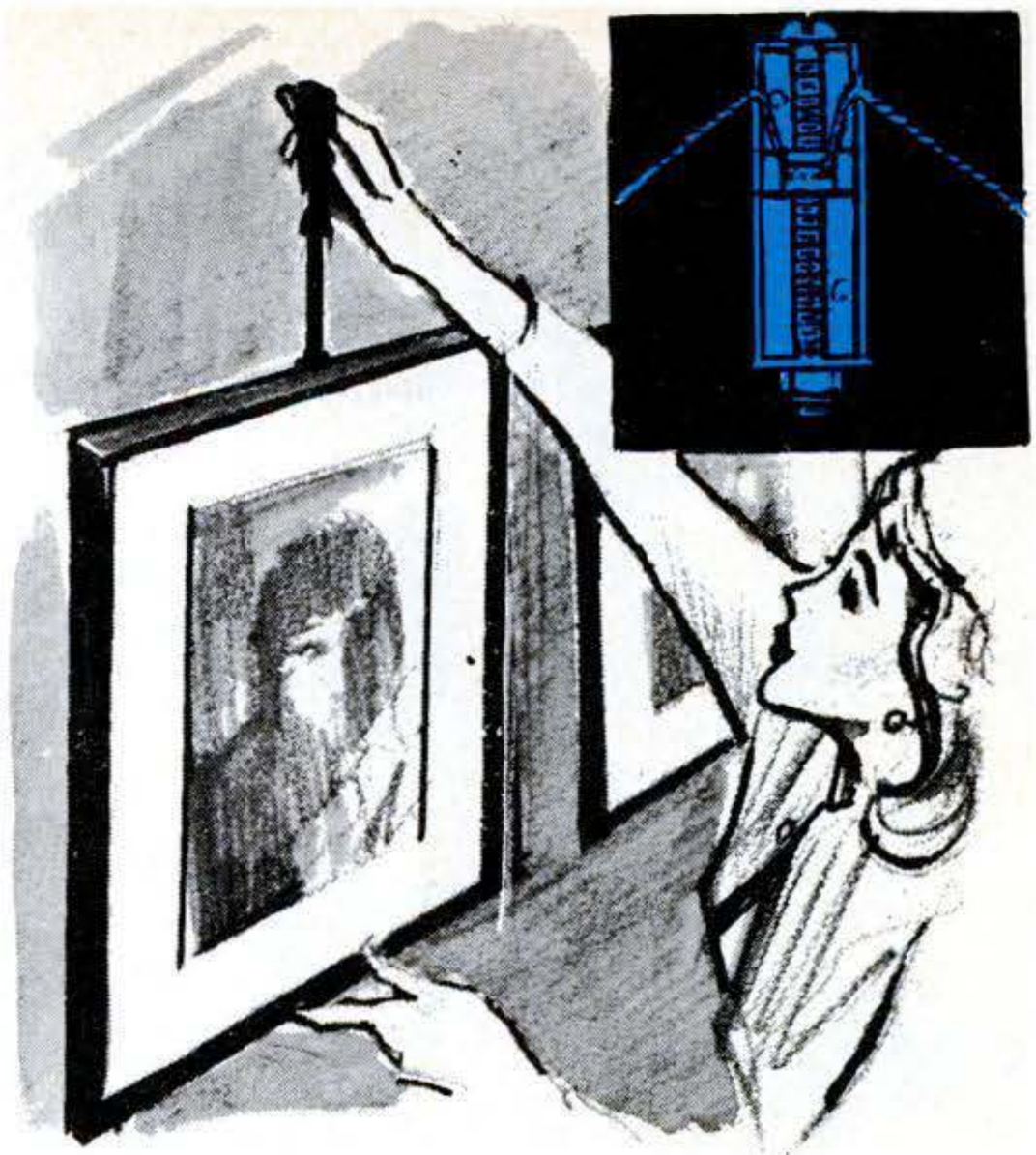
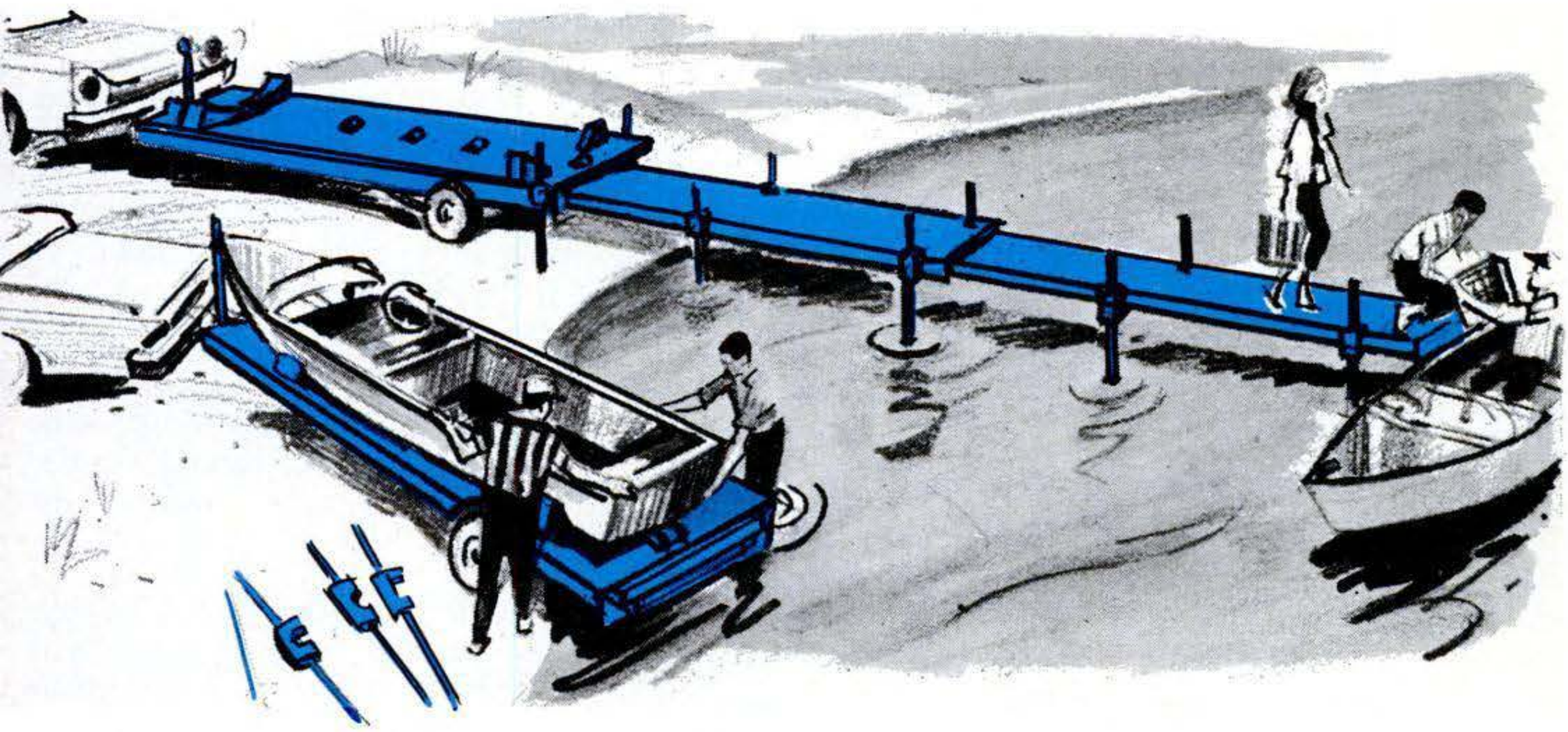


Drill attachment bevels edges. Here's a jig that would let you use an ordinary hand drill to smooth or bevel edges of wood, plastic, or other materials, or make uniform V grooves in matching panels. The chucked bit would extend through a bearing into a slotted collar that rode against the work edge. A lock nut on the threaded shank of the handle would set depth of cut.



Hanger adjusts picture height. Loop a picture wire through this adjustable hanger and you could raise or lower the picture an inch or two with just a touch of a screwdriver. It would simplify the job of lining up matching pictures on a wall, eliminate the problem of measuring hook height and wire slack. Adjustment height would vary with hanger size and screw length.



Extending trailer docks boat. Slide-out sections on this boat trailer would extend the trailer almost three times its length to form a deep-water pier for a boat after it was launched. Adjustable clamp-on supports would anchor and steady the dock sections. The extending trailer would provide a lake or river mooring that could be used by the boatman at either low or high tide.

The following patents have been issued on these inventions: **Expanding trunk**—*No. 3,233,936 to Milton Jakosky, Los Angeles;* **Lift truck**—*No. 3,225,868 to E. J. Barnes, Mira Loma, Calif.;* **Roller gear**—*No. 3,241,175 to R. J. Johnson, Phoenix, Ariz.;* **Drill jig**—*No. 3,241,453 to O. N. Baldwin, Baxter Springs, Kans.;* **Picture hanger**—*No. 3,251,569 to F. L. Rynearson, Dublin, Calif.;* **Extending trailer**—*No. 3,229,833 to D. J. and W. J. Heck, Kincheloe AFB, Mich.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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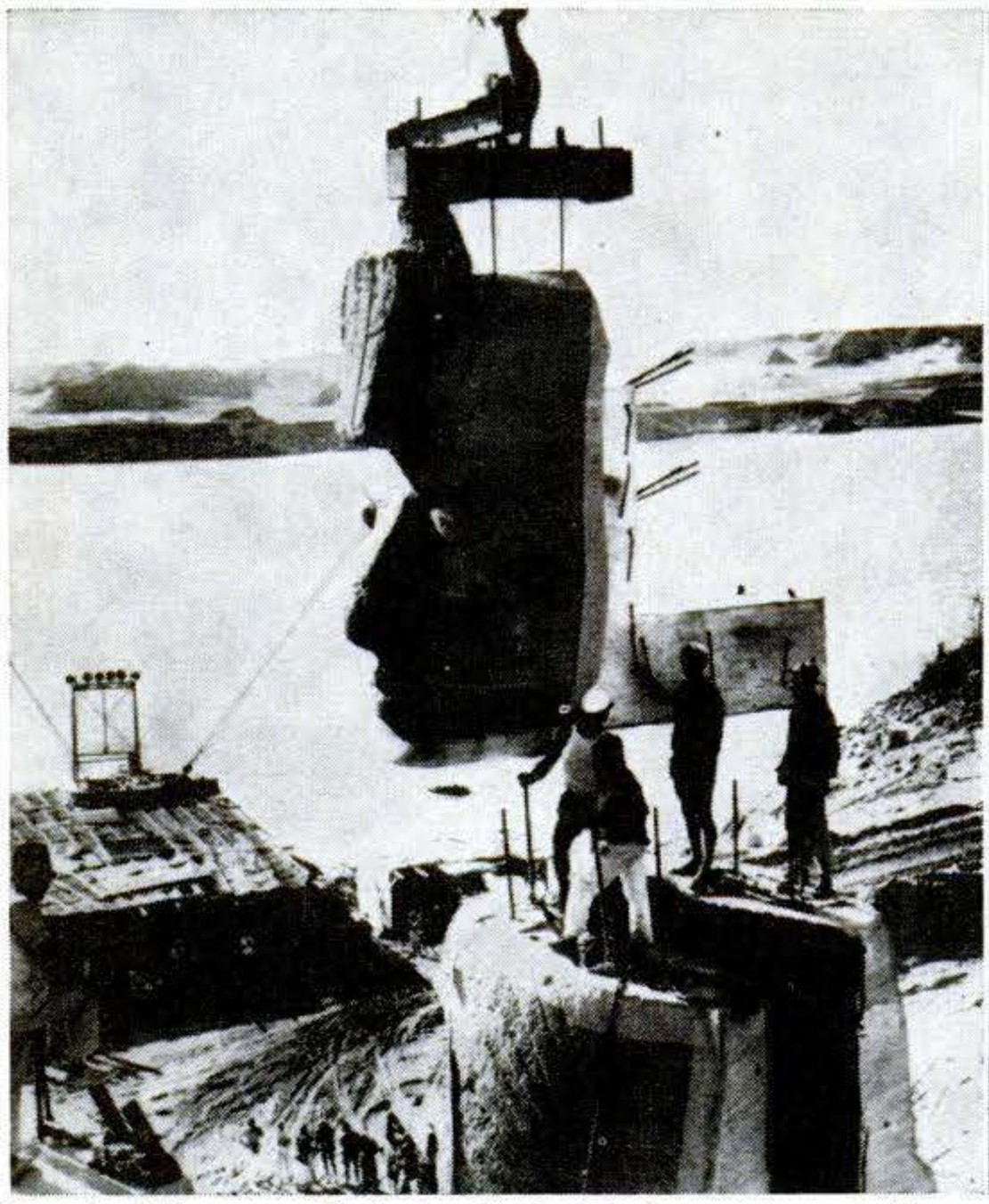
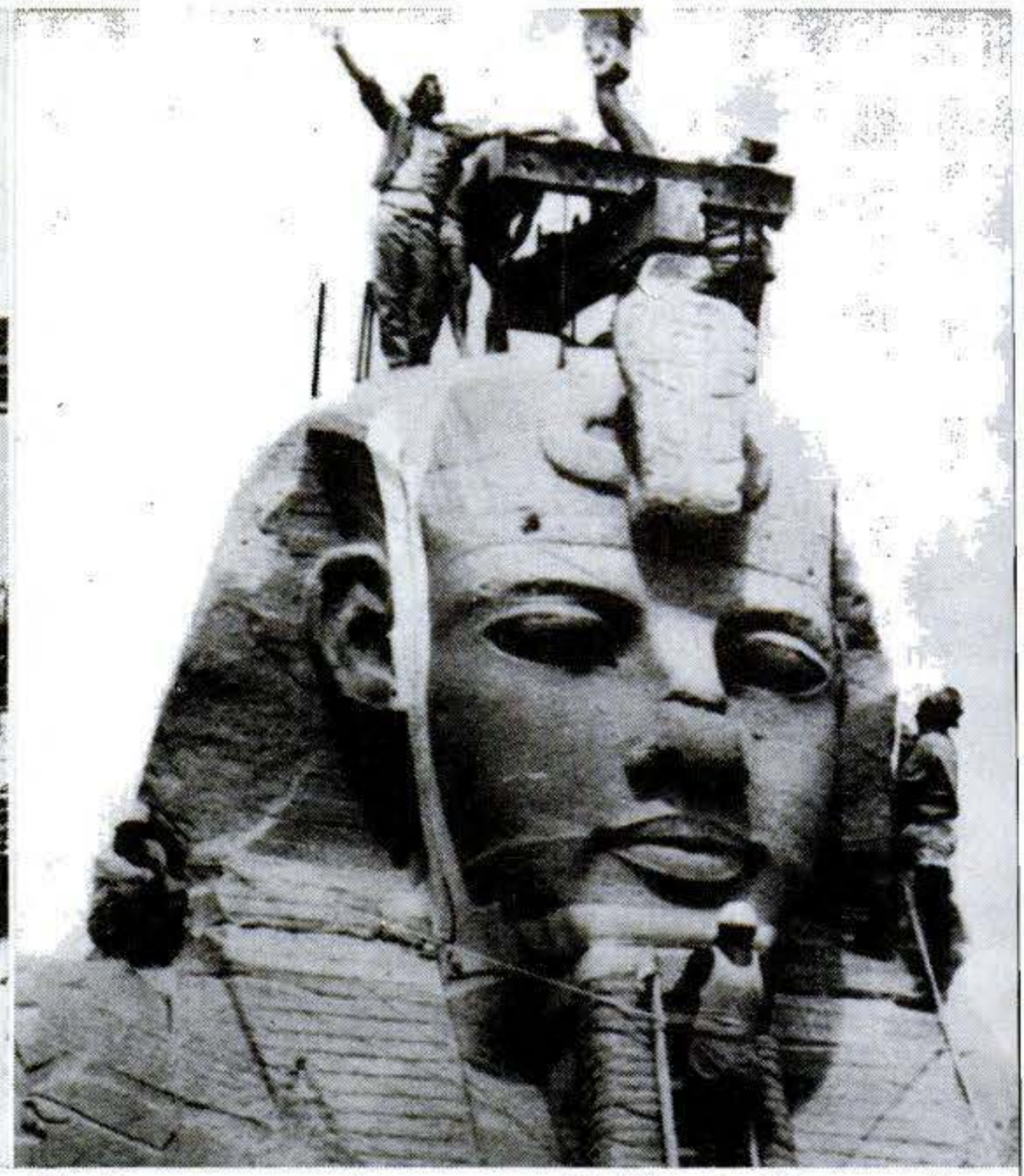


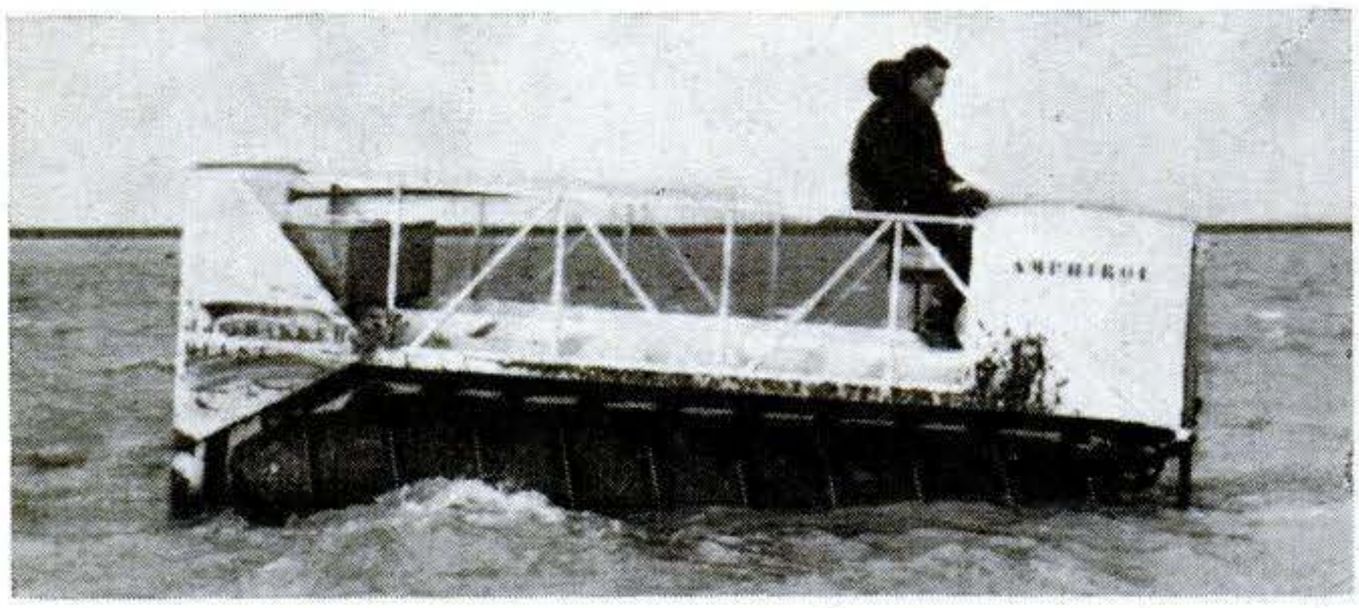
Head of Ramses II statue is hoisted up to new site.



Workmen secure the reassembled head of Ramses II.

Engineering genius saving the Abu Simbel temples

The 3,000-year-old Abu Simbel temples, which surround the tomb of Ramses II, have been prevented from being turned into a watery grave. The ancient Pharaoh's tomb is being moved to a site 300 feet higher than the original location—above the level of the Nile River waters



Dutch amphibious vehicle cruises in the water at nine m.p.h.

Screwy buggy readily negotiates muddy flats with its rollers.

Bog buggy can't bog down on land or in water

This oddball, worm-drive vehicle rides, or floats, on a pair of old grain-storage cylinders wound with helical flanges. The vehicle was designed by a Dutch machinery manufacturer who was frustrated by impossible tidal flats and sandy ooze along the bank of the Scheldt River. The "screwy" tanks have left- and right-hand threads and are driven in opposite directions by separate Volkswagen engines. These work through V-belt transmissions that give infinitely variable ratios by changing the effective diameter of the primary and secondary pulleys. The buggy does 20 m.p.h. on muddy ground, or nine m.p.h. in water. It's steered like a crawler tractor, by slowing down or braking one spiraled roller, and can move sideways by reversing one of the rollers.

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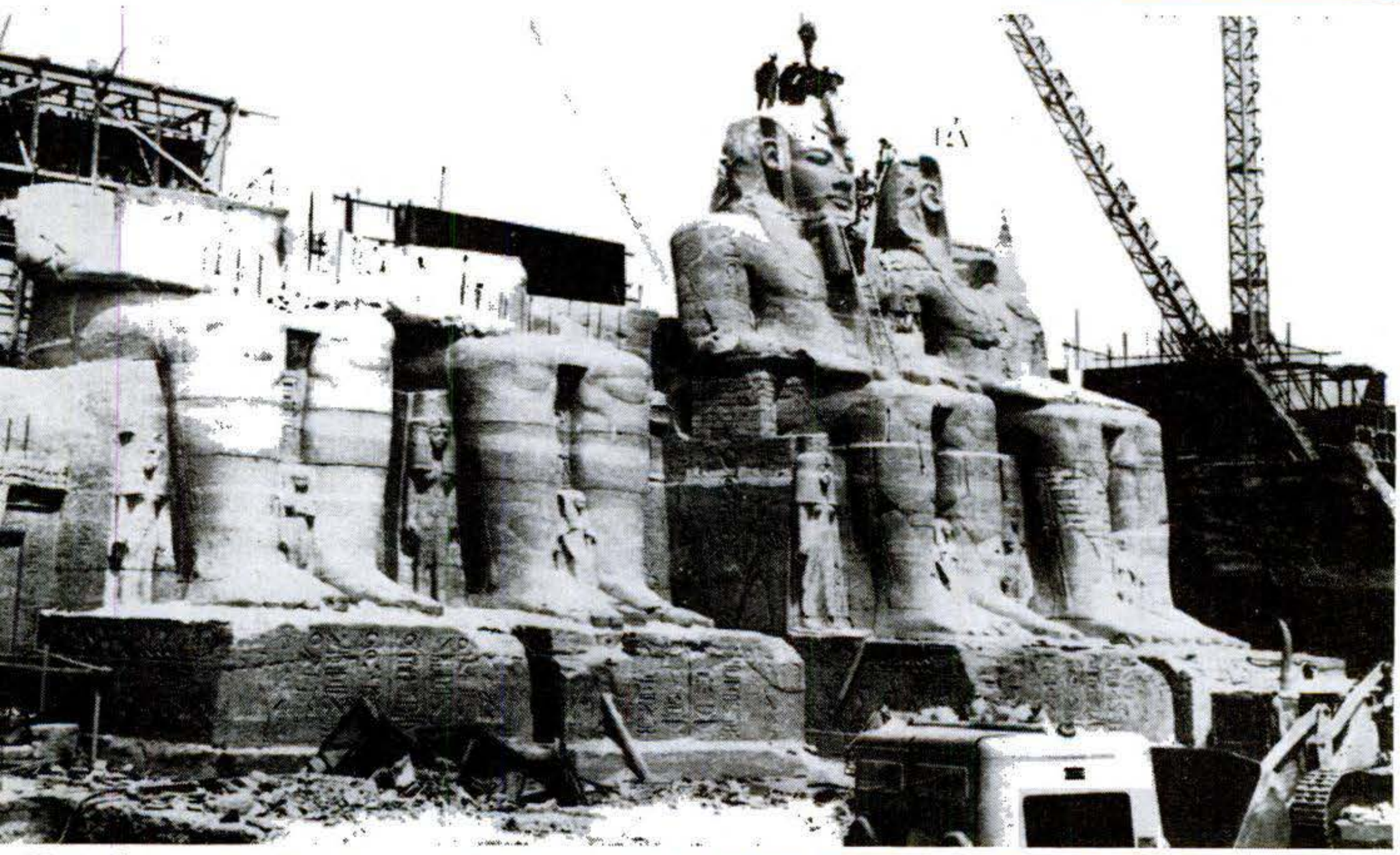
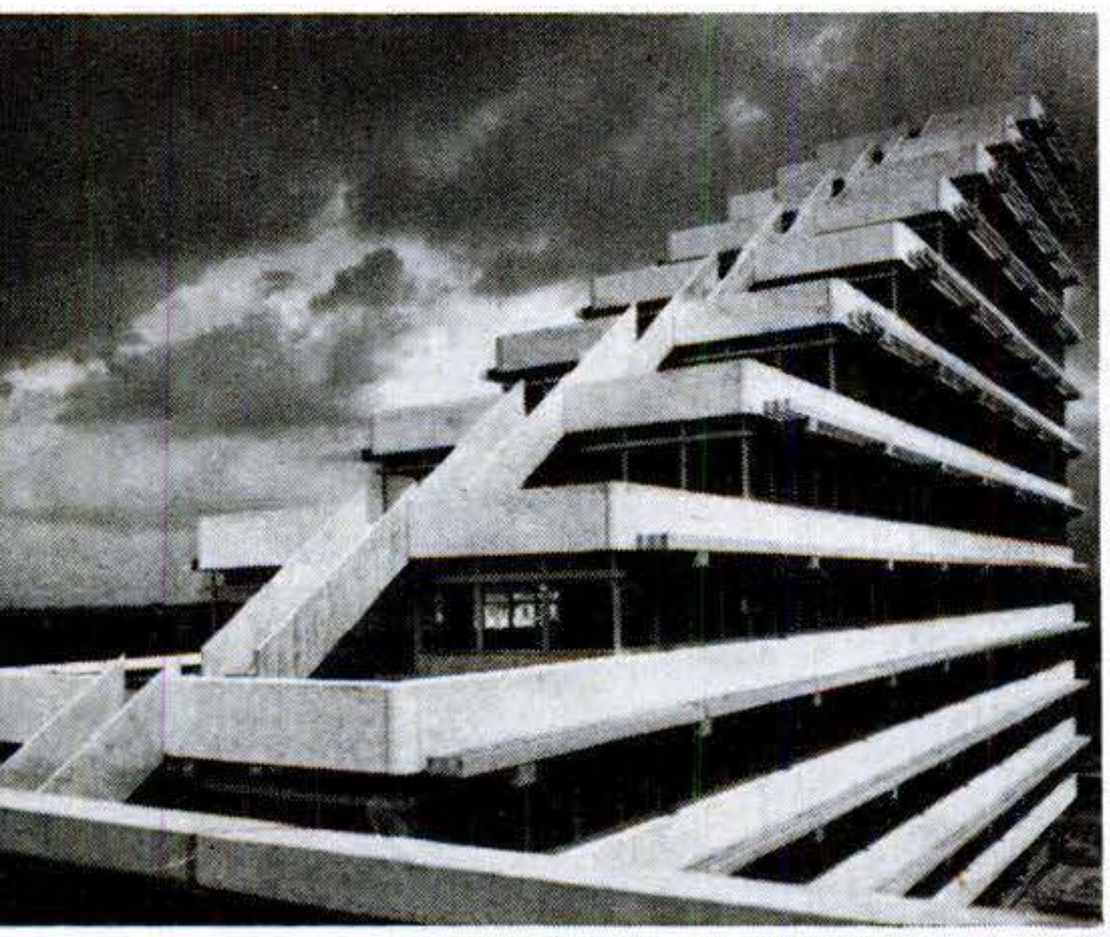


View of the entire site shows where four statues of ancient Pharaoh will be when moving is completed.

backing up behind the new Aswan Dam. The temple was built so that the tomb's entrance allowed sunlight to penetrate 200 feet into a sanctuary in which four statues of Ramses II are located. Engineers hope that in the newly erected temple the statues will again be bathed by sunlight. The United Nations is sponsoring the massive moving job, begun three years ago and scheduled for completion in 1969. It's costing $36 million, a third paid by the U.S.



Stairway to the top of the ladder

The building of Allgemeine Rechtsschutz AG, an insurance firm in Düsseldorf, West Germany, is laid out so that each floor is occupied by progressively higher-paid employees right up to the top where the president sits alone. Clerks and typists occupy the ground floor.

Scooter is electrically driven

The Morrison Midget is demonstrated at a recent transport show in London. The electrical runabout has a range of 16 miles on a battery charge. It's built for use around factories, large offices, or on private grounds. The scooter costs about $800, has a top speed of eight m.p.h.

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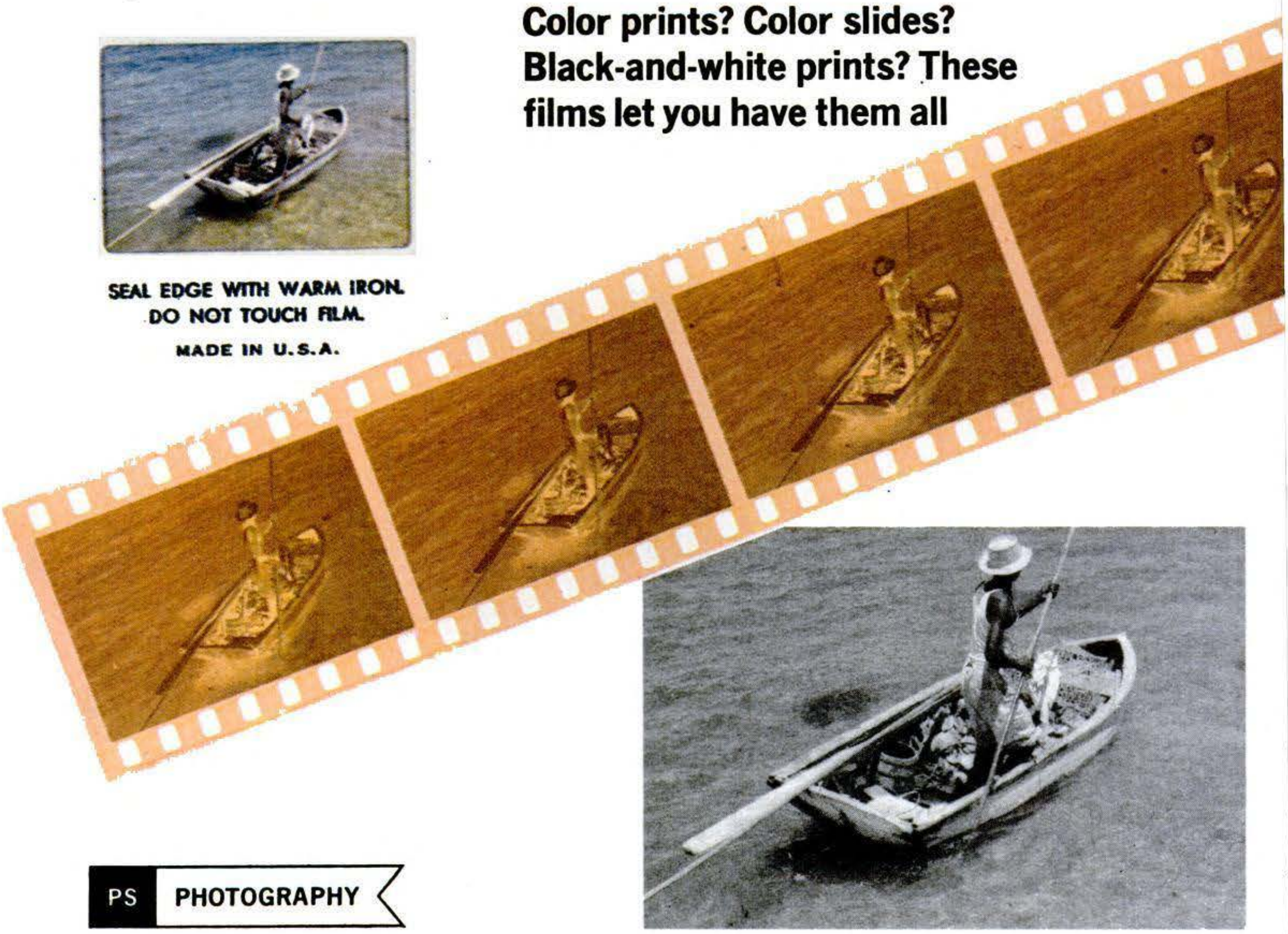
SEAL EDGE WITH WARM IRON.
DO NOT TOUCH FILM.
MADE IN U.S.A.

Color prints? Color slides? Black-and-white prints? These films let you have them all



PS **PHOTOGRAPHY**

COLOR NEGATIVE: The One

By ARTHUR GOLDSMITH
Head of Instruction,
Famous Photographers School

If you were going on a trip around the world and were limited to just *one* film, what would you choose? Tough decision? Not really. You want to come back with color prints, black-and-white prints, and color slides. Color-negative film—the closest thing to a "universal" film yet devised—will give you all three plus generous exposure latitude and the freedom to shoot interchangeably by daylight, blue flash, or electronic flash.

I'm not saying that color-negative film is the *perfect* answer to all picture-taking situations. It isn't. Black-and-white film produces superior black-and-white prints, and original color transparencies have better quality than slides made from color negatives. But when you want more than one way to skin a cat, color negative offers a useful compromise.

Professionals, as well as amateurs, have taken to the film. There are frequent situations where it just isn't practical to do double coverage in both color and black-and-white.

Black Star picture agency, for instance, recently was assigned to photograph some of our students who had offered testimonials for Famous Photographers School. We wanted to run the pictures both in color and black-and-white in various brochures and advertisements. Black Star photographers shot on color-negative film. The same negative supplied satisfactory prints for both uses.

Portrait photographers, too, are turning more and more to negative color. My friend Harry Garfield, an outstanding photographer of children, is typical of many knowledgeable professionals around the country in his increasing use of negative color. Even if the

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PHOTO BY THOMAS MAHNKEN

Film That Does Everything

customer asks only for black-and-white, he often will shoot on color negative and show a sample color proof, knowing that when the customer sees the striking, full-color print, it will be hard to resist ordering some color portraits.

Color prints. Most of us, of course, use color-negative film like Agfacolor or Kodacolor-X to get color prints. Given a good negative, an experienced lab can provide you with excellent color prints and enlargements at a reasonable cost.

Naturally, a color print—viewed by reflected light—can't have the same brilliance and sparkle as a color transparency viewed by transmitted light. But rich, lifelike, and subtle color can be captured by Agfacolor paper or Kodak Ektacolor Professional paper. And a color print is readily *accessible* in a way that a transparency is not. You can mount it in an album, hang it on the wall, carry it in your wallet—you don't have the nuisance of passing a viewer around or setting up a projector.

Most amateurs (and professionals, too) send their films out for processing by a color lab—although a growing number do their own color printing, with all the creative control and personal satisfaction this can give.

How can you get top-quality color prints from negatives when you send the work out? Best advice is to use a custom processor. A custom lab gives your print individualized treatment, and will follow your instructions regarding cropping and color quality. But custom labs are expensive, and you probably won't want to use one for all your pictures—just for a selected few of the very best. There are custom labs in most major cities, and the majority will gladly handle mail orders.

For most of your work, you'll probably deal with a mass photo-finisher, and you should

Continued

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try to make it as easy as possible for him to produce good prints from your color negatives. Read the film maker's data sheet. Follow the directions regarding exposure and filters. Failure to do these things costs snapshooters millions of dollars in wasted film each year.

What should you do if the lab goofs and prints come back too blue, too pink, or too green? Complain. If the results don't satisfy you—*and your negatives are satisfactory*—ask the lab to do them over. Most color labs try hard, but I think they'd try harder if more customers didn't meekly accept the poor jobs along with the good

Shooting with color-negative film. Color-negative films are available in sizes to fit just about any type of camera—Rapid, Instamatic, 35mm, roll-film, and sheet-film. Let's take a look at some of their general characteristics and how you can get the best results from them.

Which light is right? Versatility is the key word here. Agfacolor, Kodacolor-X, and Ektacolor Professional Film, Type S, all are designed for use with daylight, electronic flash, or blue flash. On the same roll, *without using a filter,* you can shoot by any of these light sources. You also can use blue flash or electronic flash to fill in dark shadows in daylight photography.

The daylight/blue-flash breed of color-negative film can be used with 3400K photofloods or 3200K studio lights by adding a corrective filter. However, you lose considerable speed in doing so. Kodacolor-X, for instance, has a daylight rating of ASA 80 without a filter. With an 80B filter and photoflood, the speed drops to ASA 25—which is no problem as long as your shutter speed is 1/10 second or faster. At slower speeds you begin to encounter tricky problems of color shift and reciprocity failure. (Kodak's Ektacolor Professional, Type L, is an exception. Supplied in sheets only, it's balanced for 3200K lighting and designed for exposures of 1/10 second and longer. It's most commonly used for posed portraits, still lifes, and other professional studio shooting.)

How much speed and latitude? The speed of color-negative films ranges from Agfacolor's ASA 40 through Kodacolor-X's ASA 80 to ASA 100 for Ektacolor Professional, Type S. The Kodak ratings, incidentally, are new. Kodak recently upped the exposure index of its color-negative films by ⅓ stop—the result of new ASA standards (the film emulsions themselves are unchanged). If you still have a box of Kodacolor-X with the old, lower rating, use the new ASA rating of 80 when you shoot.

All the daylight/blue-flash color-negative films are fast enough for making indoor pictures by bright windowlight. This is a lovely type of light for portraits and still-life photography—I often recommend it to my students. Use a window on the north side of the house or any other location that gives you soft, *indirect* illumination rather than harsh, direct sunlight. If a slow shutter speed is required, use a tripod to avoid camera shake.

In terms of exposure latitude, color-neg-

Color-Negative Films at a Glance

FILM	AVAILABLE SIZES	LIGHT SOURCES				
		Daylight	Electronic Flash	Blue Flash	3400°K Photoflood	3200°K Studio
Agfacolor CN17	35mm, 120 rolls, sheets	no filter ASA 40	no filter ASA 40	no filter ASA 40	82A filter ASA 32	82C filter ASA 20
Agfacolor CN17S	Rapid cartridges	no filter ASA 40	no filter ASA 40	no filter ASA 40	82A filter ASA 32	82C filter ASA 20
Ektacolor Professional, Type S	620, 120, 220 rolls, sheets, 35mm in 100-ft. bulk rolls only	no filter ASA 100	no filter ASA 100	no filter ASA 100	80B filter ASA 32	80A filter ASA 25
Kodacolor-X	35mm, 126 (Instamatic) cartridges, most roll-film sizes	no filter ASA 80	no filter* ASA 80	no filter ASA 80	80B filter ASA 25	80A filter ASA 20
Ektacolor Professional, Type L**	sheets only	85 filter ASA 64 (at 1/10 sec.)	not recom-mended	not recom-mended	81A filter ASA 64 (at one sec.)	no filter ASA 100 (at 1/10 sec.)

*But if prints are consistently bluish, try an 81B filter or equivalent
**A professional sheet film designed for exposures of 1/10 second or longer

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ative films are much less demanding than are color-transparency films. You have a hefty margin for error, so there's no need for "bracketing" in a tough exposure situation. (Of course, you should still expose as accurately as you can.)

Just how much exposure latitude any color-negative film "really" has depends on what standards you set and the skill of the printer. An ultraconservative estimate would be one stop under and two stops over. In practice, however, you'll find that any exposure within a range of two stops under and four over will give you printable negatives. If in doubt, remember that you have a little more margin for safety on the *overexposed* side.

Black-and-white prints. Satisfactory — even excellent—black-and-white prints can be made from color negatives. But I've never seen one that could match the quality of a fine print from a really good black-and-white negative. For best results—especially from 35mm color negatives—print small: say 4-by-5 or 5-by-7. This minimizes the problems of unsharpness, low contrast, and somewhat mushy grain pattern that often give trouble when you try to make big enlargements.

Color-negative film really comes in handy in those family situations where you get lots of requests for extra prints. If you do your own darkroom work, you can make inexpensive black-and-white prints and keep everyone happy.

With Agfacolor-CN17 negatives, any black-and-white paper and your normal safelight can be used. Agfacolor CN17S (the type currently supplied in Rapid loads), Kodacolor-X, and Ektacolor contain color couplers that provide automatic "masking" for color printing. This masking—the familiar orange cast on the color negatives—tends to increase the required printing time and to reduce contrast. (Use a contrast grade or two more than normal to give your print enough snap.) In prints from "orange" color negatives on ordinary black-and-white printing paper, the reds will tend to go darker and the blues lighter than normal.

Professional-quality prints can be made on regular black-and-white paper. However, many darkroom workers find they get better results more easily with Panalure, a panchromatic paper especially designed for use with masked color negatives. (But don't use your regular safelight with Panalure; you need a Wratten Series 10 [dark amber] safelight.)

How about color slides? Naturally, you won't shoot on color-negative film if your main purpose is to obtain color slides. An original transparency usually is superior in quality to a slide made from a color negative. In the duplicating process there is a loss of sharpness and increase in contrast. But the possibility of making a transparency from a color negative is a valuable ace in the hole when you want to fill out a slide show.

Like any other film, color-negative has limitations as well as advantages. Although it can do almost anything, it doesn't do everything best, and a well-rounded photographer will use it with discrimination, along with black-and-white and color-transparency films. When you want color prints, it's the logical choice, of course. And when it's inconvenient—or impossible—to shoot in both color and black-and-white, color-negative can be a blessing. Once considered a film for the box-camera snapshooter, today it is deservedly winning the respect of professionals and serious amateurs. Maybe it's the answer to some of your picture-taking needs, too. PS

And don't forget: Tips for perfect color prints

- Read the film data sheet. Many disappointments can be avoided if you just follow the directions.
- Don't "cook" your film by leaving it or your camera in bright sunlight, a hot glove compartment, etc.
- Have your exposed film processed promptly—don't leave it in the camera for a long period.
- If you're storing color-negative film over a period of time, keep the *unopened* box in your refrigerator (not the freezer unit). Let film warm about four hours before using.
- If prints consistently come out bluish with strobe, use an 81B filter or equivalent to warm up the tones.
- Avoid touching the surface of color prints—the emulsion is easy to scratch or mar with fingerprints.
- Don't hang a color print exposed to direct sunlight. It may cause the print to fade or change color.

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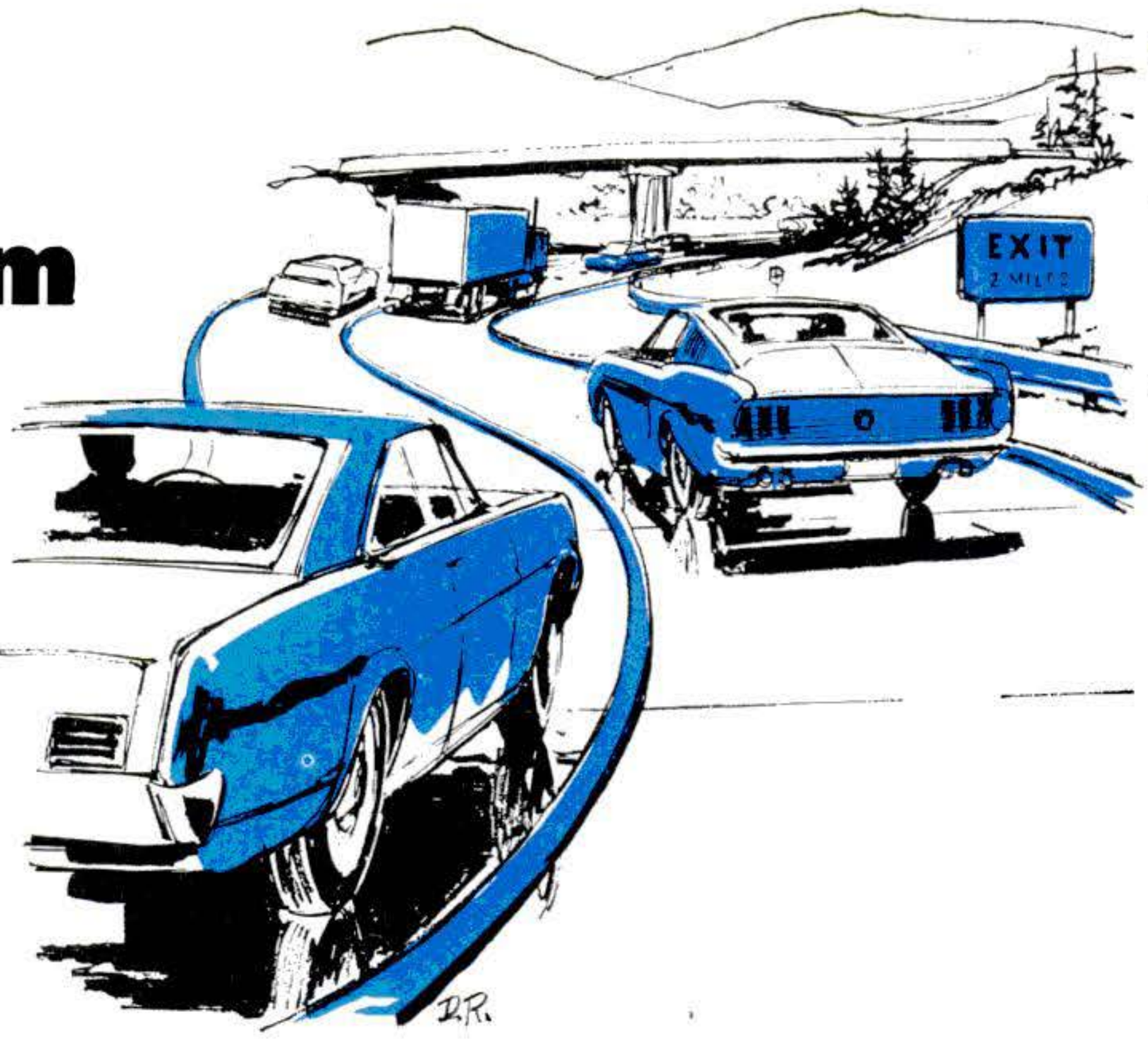
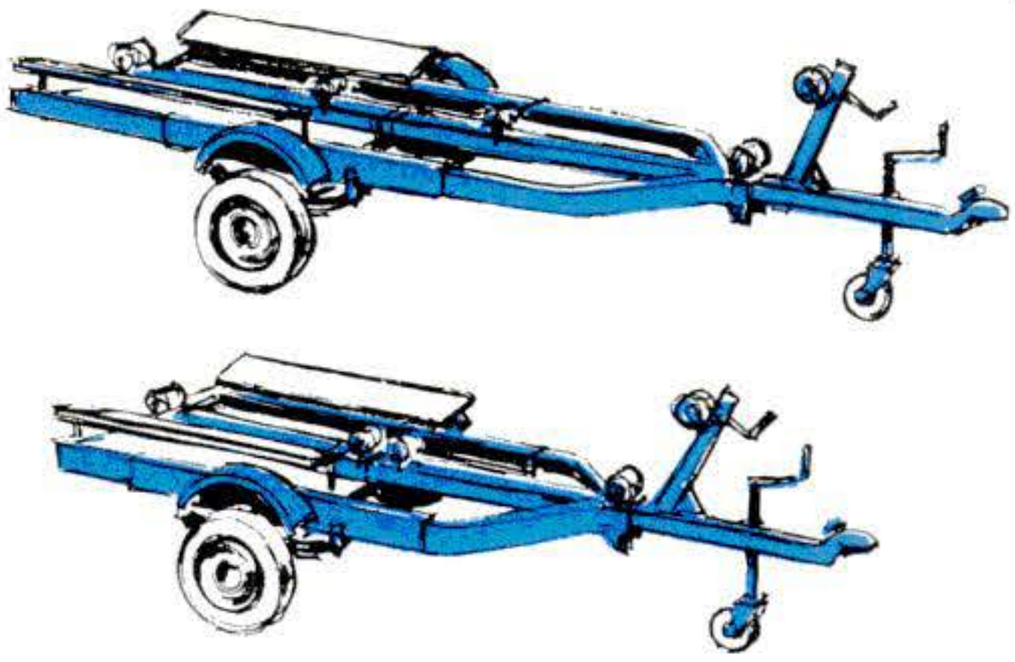
"I'd like to see them make . . ."

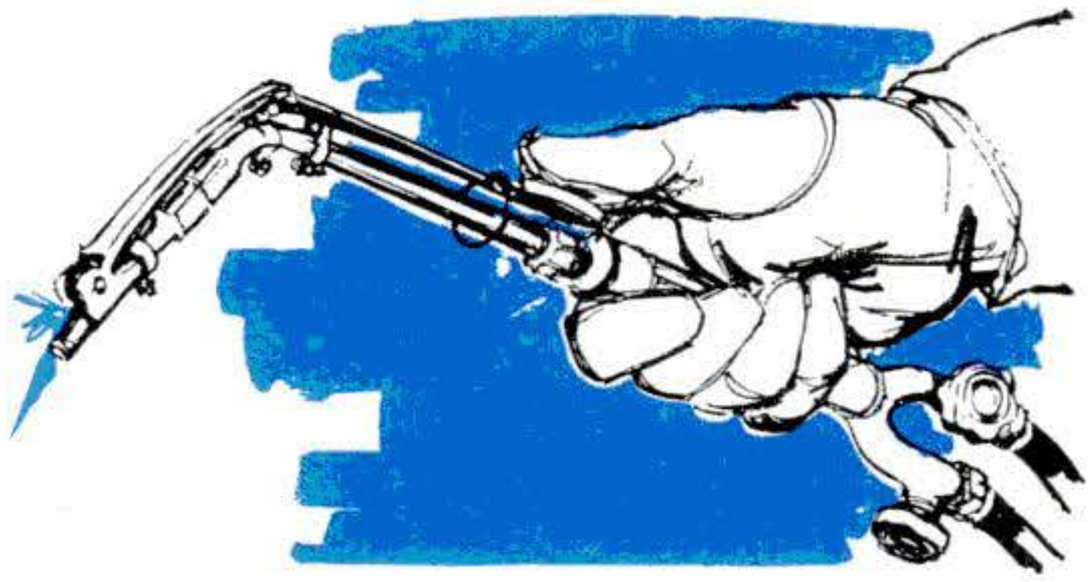
DRAWINGS BY DANA RASMUSSEN



Fluorescent dividers and edge markers on turnpikes where fog is frequently a problem. They'd add to safety for night drivers, too.—*F. M. Scott, Leonia, N.J.*



Boat trailers that would telescope to take up less room when stored. They could also be used for hauling many things around the yard when retracted.—*Robert Glazer, Flagstaff, Ariz.*



Built-in flints on welding torches, worked like cigarette lighters. Press a button, and the flint at the tip of the torch would produce a healthy spark.—*Paul Kaemmerling, Hull, Tex.*

An inflatable umbrella of plastic with slightly stiffer plastic "ribs." It would fold into a telescoping tubular handle through which you'd blow it up.—*Alan Robbins, Buffalo, N.Y.*

A lift-up handle on full-size typewriters for carrying, to leave you one hand free for opening doors. It could fold flat in a groove when not in use.—*Andy Vena, Philadelphia.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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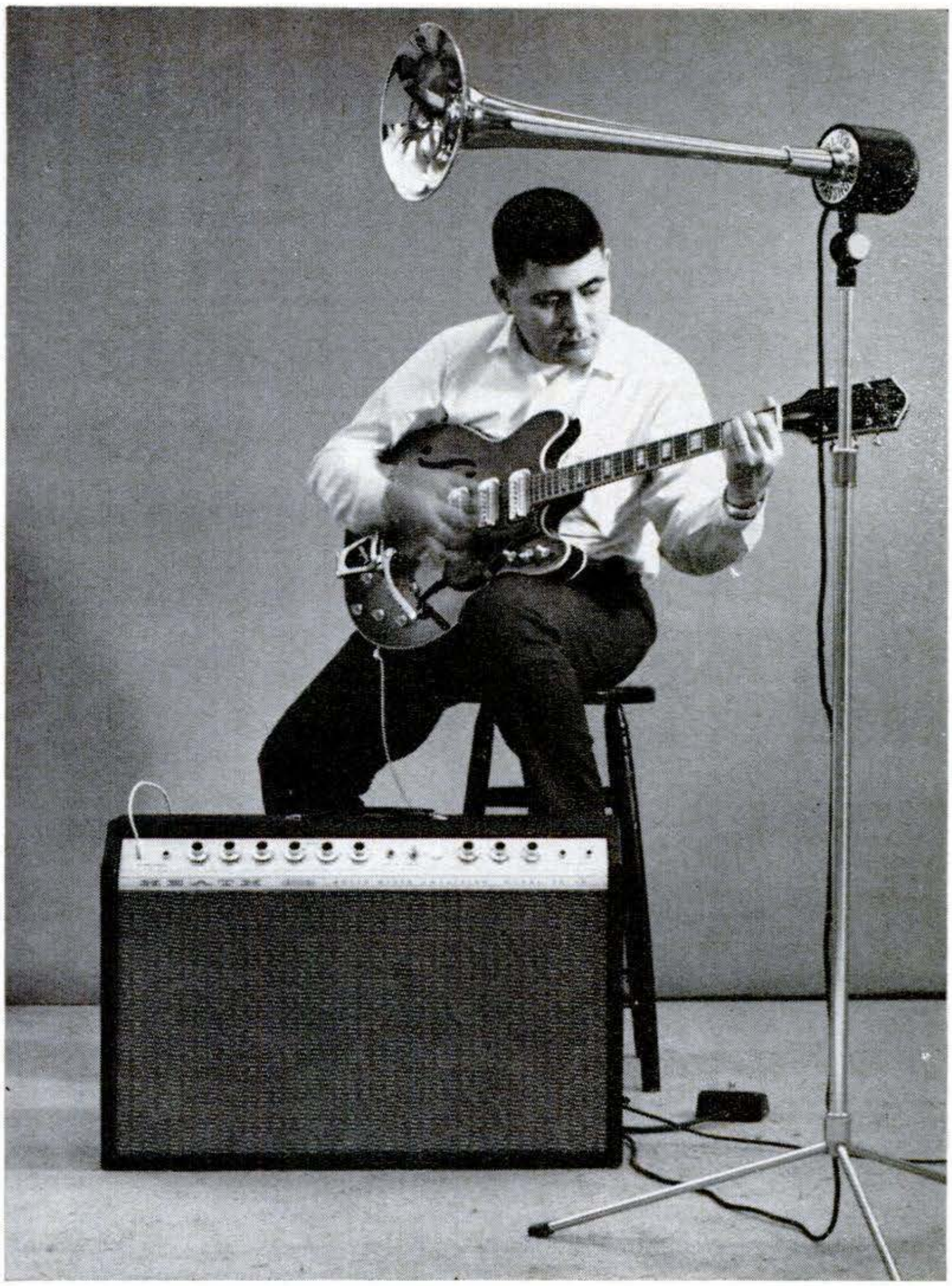
WHAT'S NEW

ELECTRONICS

Here's a Trio of New Electronic Music Makers

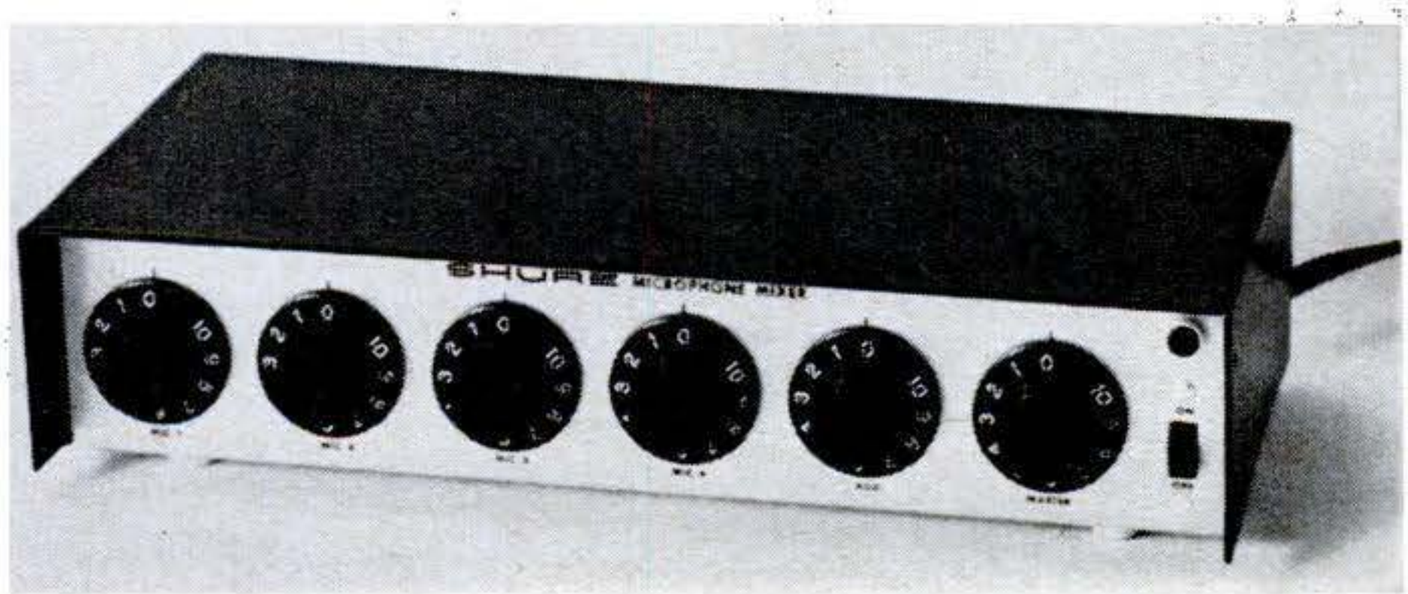


An electric guitar that comes in a kit? Sure. It's Heathkit's new TG-46 (I'm playing it in the photo at right). The body comes assembled and finished; you mount the three magnetic pick-ups and their sextet of individual volume and tone controls. The $190 kit includes a movable "tailpiece" that lets you add a wow-wow effect to the sound the guitar makes by varying the string tension.

Also new from Heathkit: an instrument amplifier with a built-in reverberation chamber to create eerie echo effects. Its transistorized circuitry can deliver up to 60 watts of power to the twin 12-inch speakers. This kit costs $130.

If you're looking for really unusual sound, you can team the guitar and amplifier with the Brass Horn (right, in photo), a special-purpose loudspeaker made by the Wurlitzer Company. When the guitar is plucked briskly, the Brass Horn beams out an amazingly close imitation of the music a trumpet makes. It's $190.—*R. Benrey.*

This transistorized "mixer" blends the outputs of a quartet of microphones



Plug four mikes—either low or high impedance—into this new Shure mixer, and the device will blend the output of each individual microphone into a single audio signal. An auxiliary input lets you add the output of a tape recorder or tuner to the mixed signal. The mixer sells for $75.

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Plenty of get-up-and-go: The brand-new Evinrude Starflite 100-S made short work of getting offshore from Gulfport, Miss. She's vibration-free, and quiet even from this checkout position close to the transom. The engine has speed, as shown here, but later idled smoothly without complaint.

PS BOATING

Evinrude's 100-S:

It set the world outboard speed record of 130.9 m.p.h., yet it runs easily at a sustained troll

By JIM ROE / *PS Boating Editor*

Any outboard motor that hot-rods its way to a new world's record at better than 130 m.p.h. is worth a second look.

When that same motor performs sedately for an afternoon on the family runabout, and is willing to chug along at trolling speeds without getting jumpy, you know you've come upon a piece of machinery you just have to drive to believe.

So drive it I did.

The scene was the Gulf of Mexico, off Gulfport, Miss.—home of the shrimp-boat fleet and Barney's Marina. H. E. "Barney" Barham was all for the idea when we suggested we put the 1967 Evinrude Starflite 100-S through her paces. His staff rigged the big 263-pound motor on the transom of a 16-foot fiberglass boat, and slipped the rig into the Gulf.

Fresh out of the box, she idled us smoothly and sedately through the harbor. No stalls or spits, just the smooth-running

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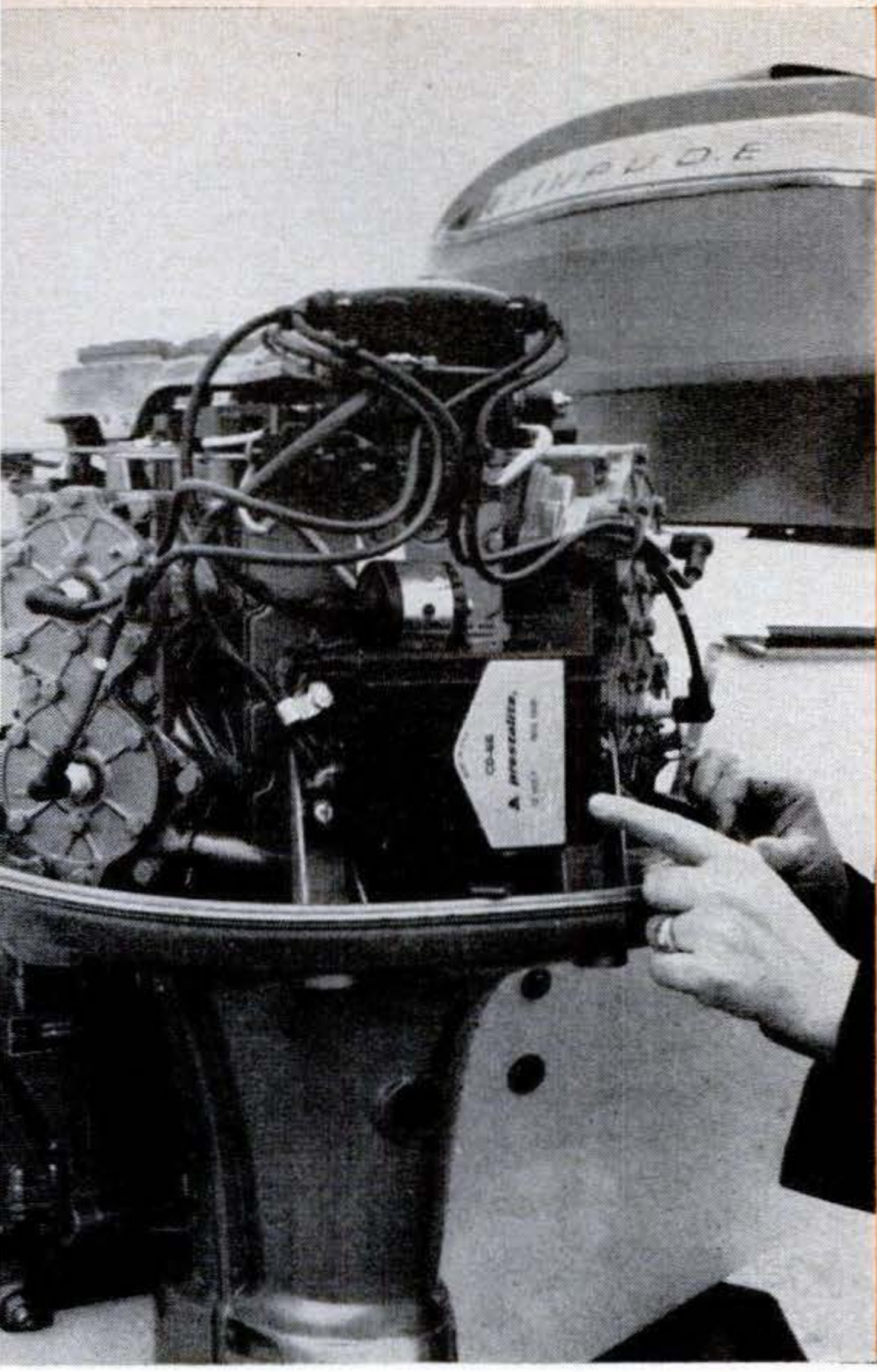
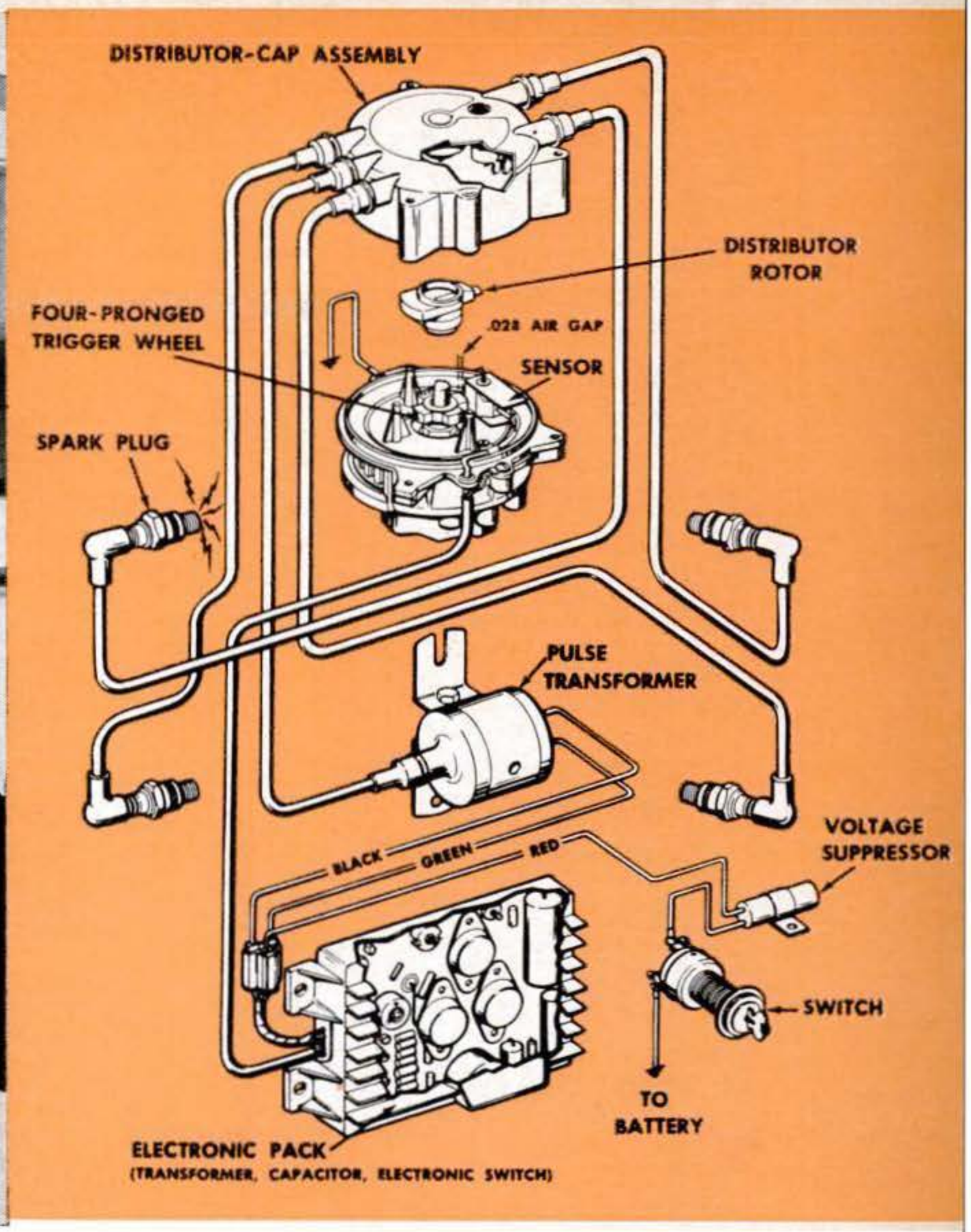


Pulse pack, part of the capacitor-discharge system, contains a converter, transformer, charging circuit, capacitor, silicon-controlled rectifier.



How the CD ignition system works: Energy from battery flows through electronic pack, is boosted to 25,000-27,000 volts on its way to spark plug.

Good-Natured Speed Demon

idle one might expect from a fully broken-in motor.

Once outside, it was time for a little excitement. An incoming freighter loomed offshore. Setting a course to bring us a safe distance abeam the vessel, I shoved the throttle to its farthest-forward notch and we took off.

Our hurriedly rigged test boat was not equipped with a speedometer, so we had

Continued

She's a joy to drive! At full throttle, 100-S proves her talents as a record-setting speedster.

She came down to idle smoothly with no hint of a stall

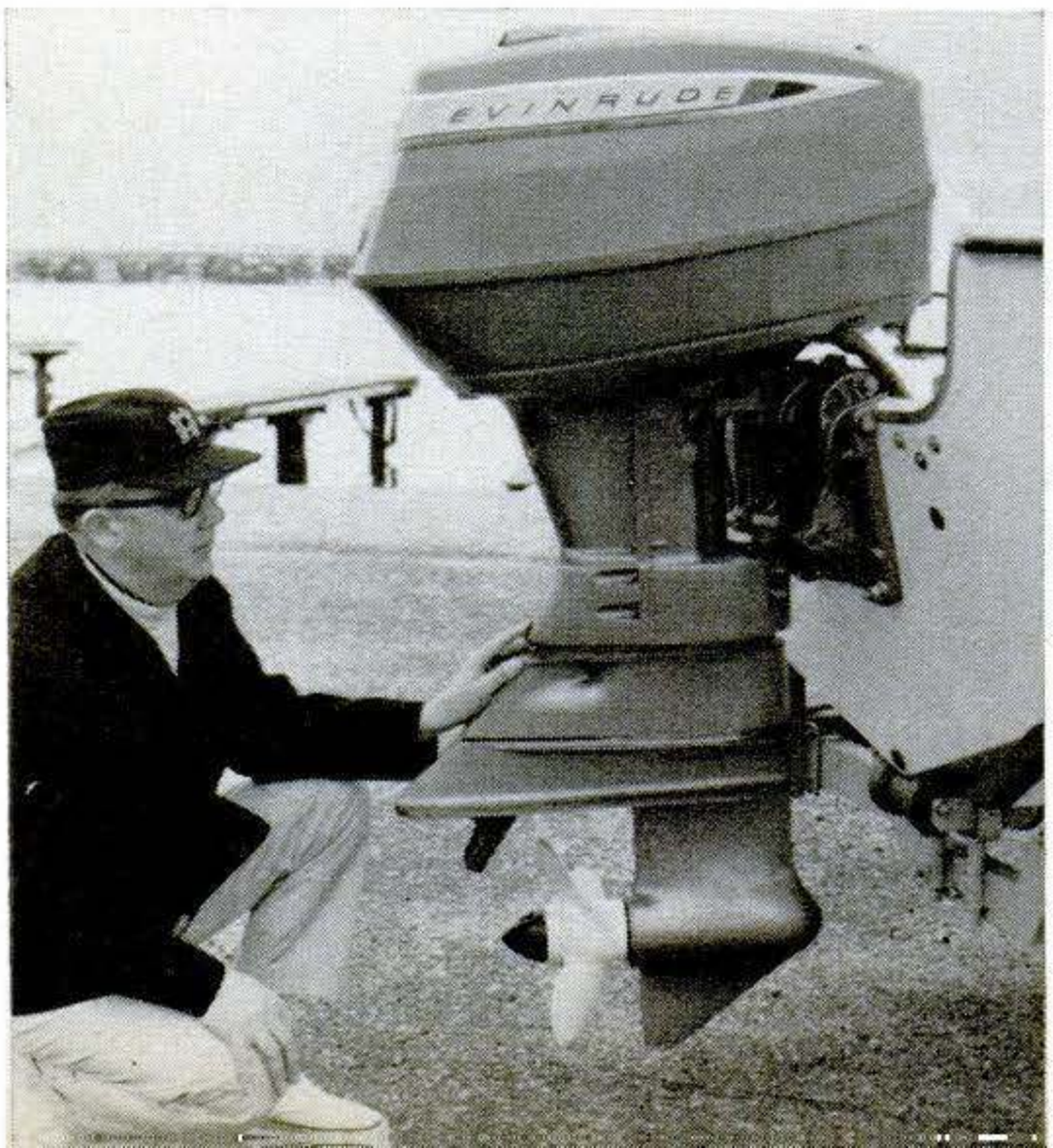
to judge speed by the seat of our pants and the whip of the slipstream when our faces were above the windshield. With three men aboard, we estimated our craft hit a good 45 m.p.h. in spite of a short Gulf chop.

Abeam the freighter we slowed down to comfortably ride the swell she was creating. The 100-S came down to idle smoothly and positively, with no suggestion of a stall. In subsequent test runs, which combined high-speed maneuvering with intermittent quick adjustments to idling, the story was always the same. Perfection.

SPECIFICATIONS

Certified brake horsepower	100 hp. at 5.000 r.p.m. Approved full-throttle range: 4,500-5,500
Speed range	Slow troll to over 45 m.p.h.
Power head	Two-cycle, 90-deg. V-4 short-stroke engine
Displacement	89.5 cu. in.
Bore and stroke	3⅜" × 2½"
Carburetion	Four-bbl. with fixed high-speed jets. Automatic choke with electric boost
Ignition	All-electronic CD breakerless system
Generator	15-amp flywheel alternator
Starting	12-volt electric, key-turn. Emergency manual rope
Controls	Pushbutton Selectric shift controls furnished
Weight	263 lb.
Price (FOB Milwaukee)	$1,325

Competent—that's the word for this chunk of machinery. This is a big motor. It weighs 263 pounds, fits a 20-inch transom. Stern bracket has a trim adjustment, a tilt lock, shock absorbers.



One could see how a modified version did indeed set the world's outboard speed record of 130.9 m.p.h. on March 16, 1966, on Lake Havasu in Arizona.

Evinrude engineers give much of the credit for the unit's good manners both as a racing motor and as a runabout or fishermen's trolling motor to its new electronic ignition.

CD ignition. It's a capacitor-discharge system. Instead of breaker points, coil, condenser, and distributor cam of the conventional ignition system, the CD system uses a converter, transistor, rectifier, capacitor, transformer, silicon-controlled rectifier, triggering wheel, and sensor. And they combine all these space-age-sounding parts with long-lasting surface-gap spark plugs which virtually eliminate pre-ignition problems. As you know, the surface-gap spark plug has no projecting electrodes to corrode and foul. It operates at a temperature almost 1,000 degrees cooler than the conventional spark plug, which helps prevent the glowing particles that cause pre-ignition.

In addition to longer spark-plug life, there are no breaker points to wear. Moisture and vibration cause no ignition problems. Evinrude engineers report that an engine using the CD ignition system is more tolerant of varying carburetor settings and fuel mixtures, and gives improved operation at the extremely low throttle settings required for trolling.

How it works. Want to follow an ignition spark through the system? Energy or voltage from the battery is fed into the electronic pack. Here the converter changes this direct current to alternating current and a transformer steps up the voltage from 12 to about 300. It is rectified back to direct current and charges a capacitor. When one of the lobes of the trigger wheel passes the sensor inside the distributor, it generates a pulse that causes the electronic switch to close. This dumps the 300-volt energy from the capacitor into the pulse transformer, which boosts it to a mighty 25,000-27,000 volts to fire the spark plug.

All this, of course, at a rate of up to 20,000 times a minute!

A good motor to win a race with—the 100-S. Or to fish or idle away a sunny afternoon. PS

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Portable fuel tanks should always be filled on the dock. Spilled fuel can be wiped off.

A Flexible Fuel System for Your Outboard

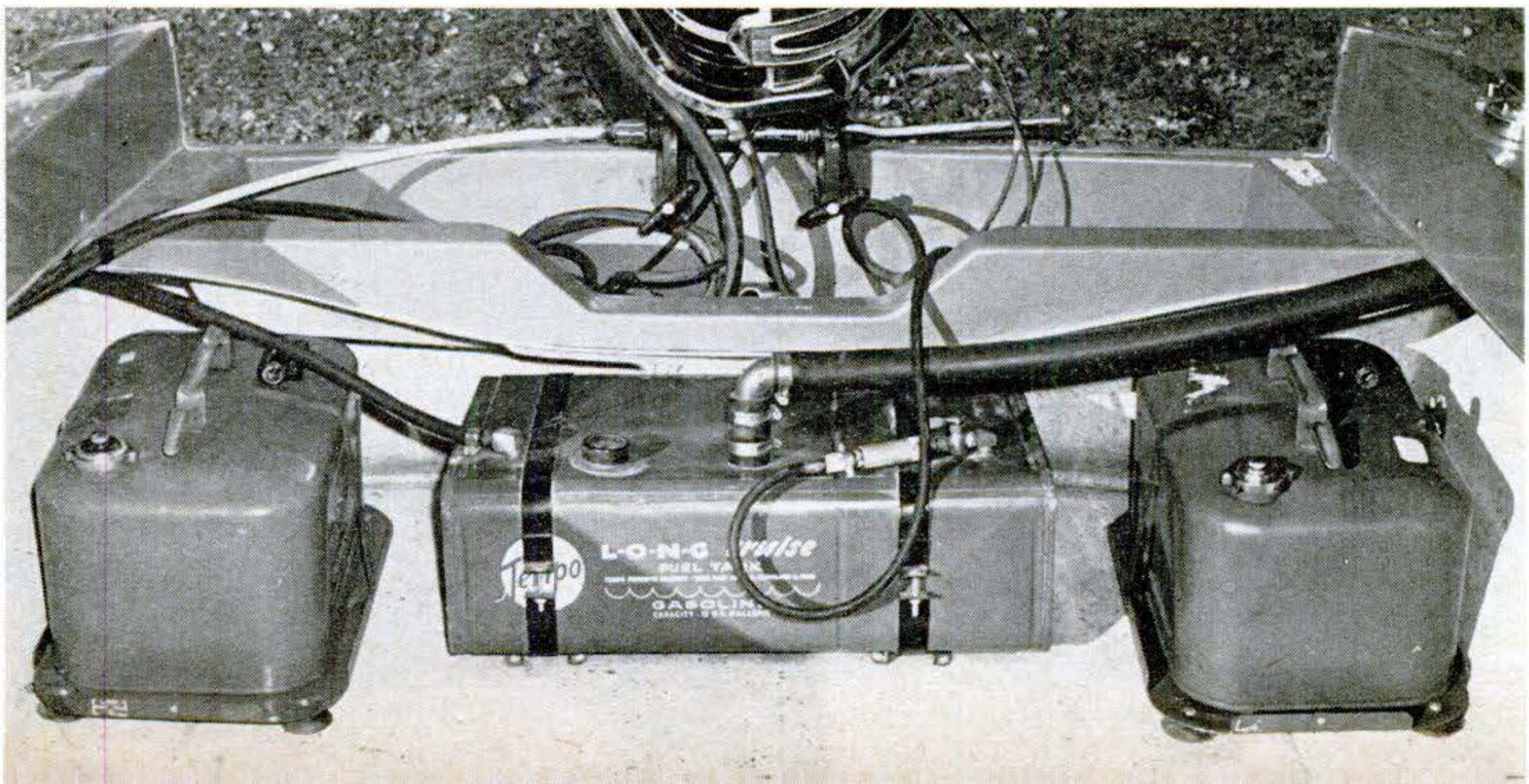
By FRED C. CLARK JR.

Here's a system that gives you complete fuel flexibility: It frees you from carrying extra fuel you don't need when you're out for a fast spin, where extra weight cuts performance, yet lets you double your fuel capacity for those long weekend cruises.

The secret: two portable six-gallon tanks as auxiliaries to the main 12-gallon tank.

Continued

Quick-release straps hold portable tanks in cradles; suction cups anchor the cradles.



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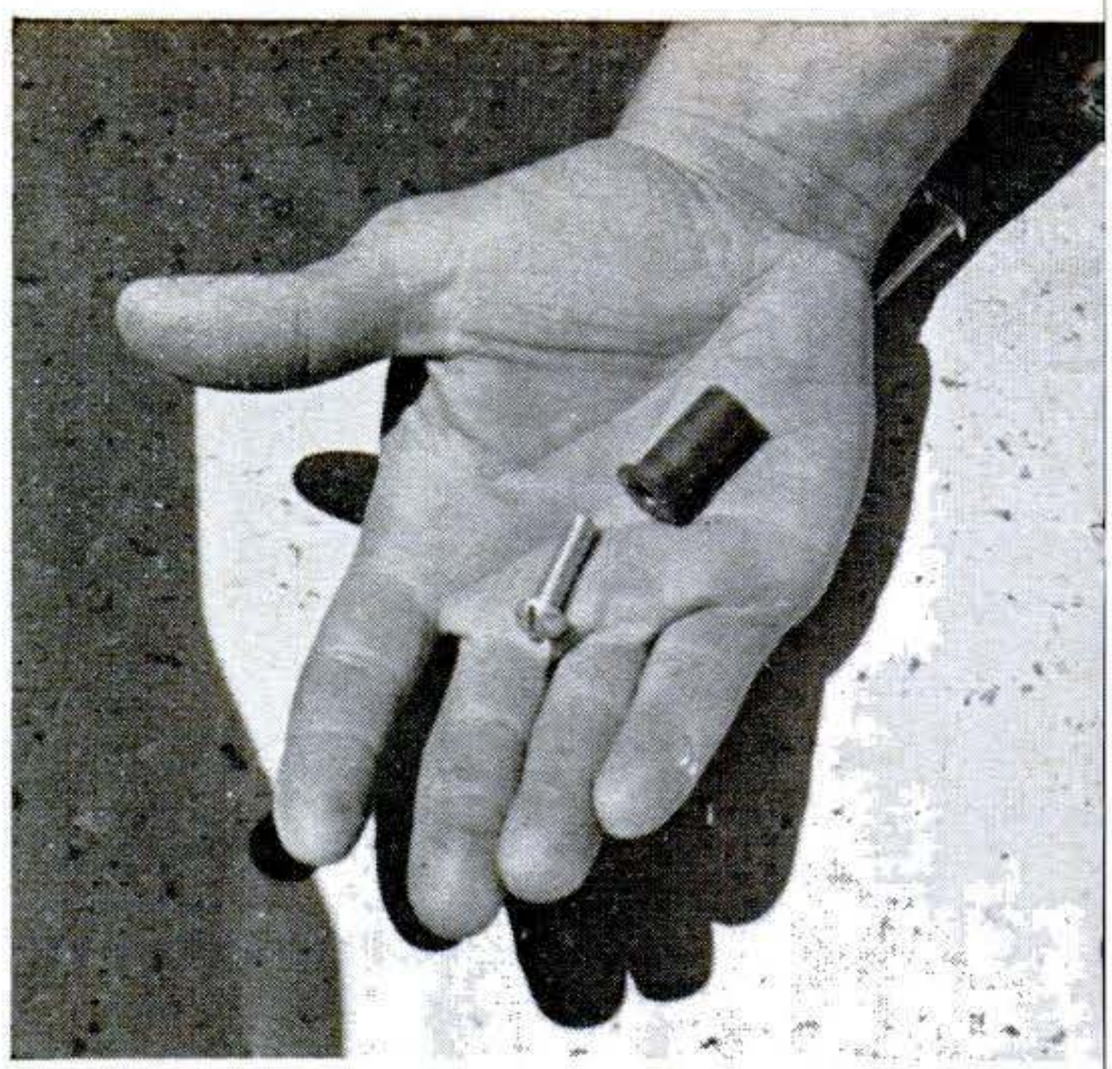
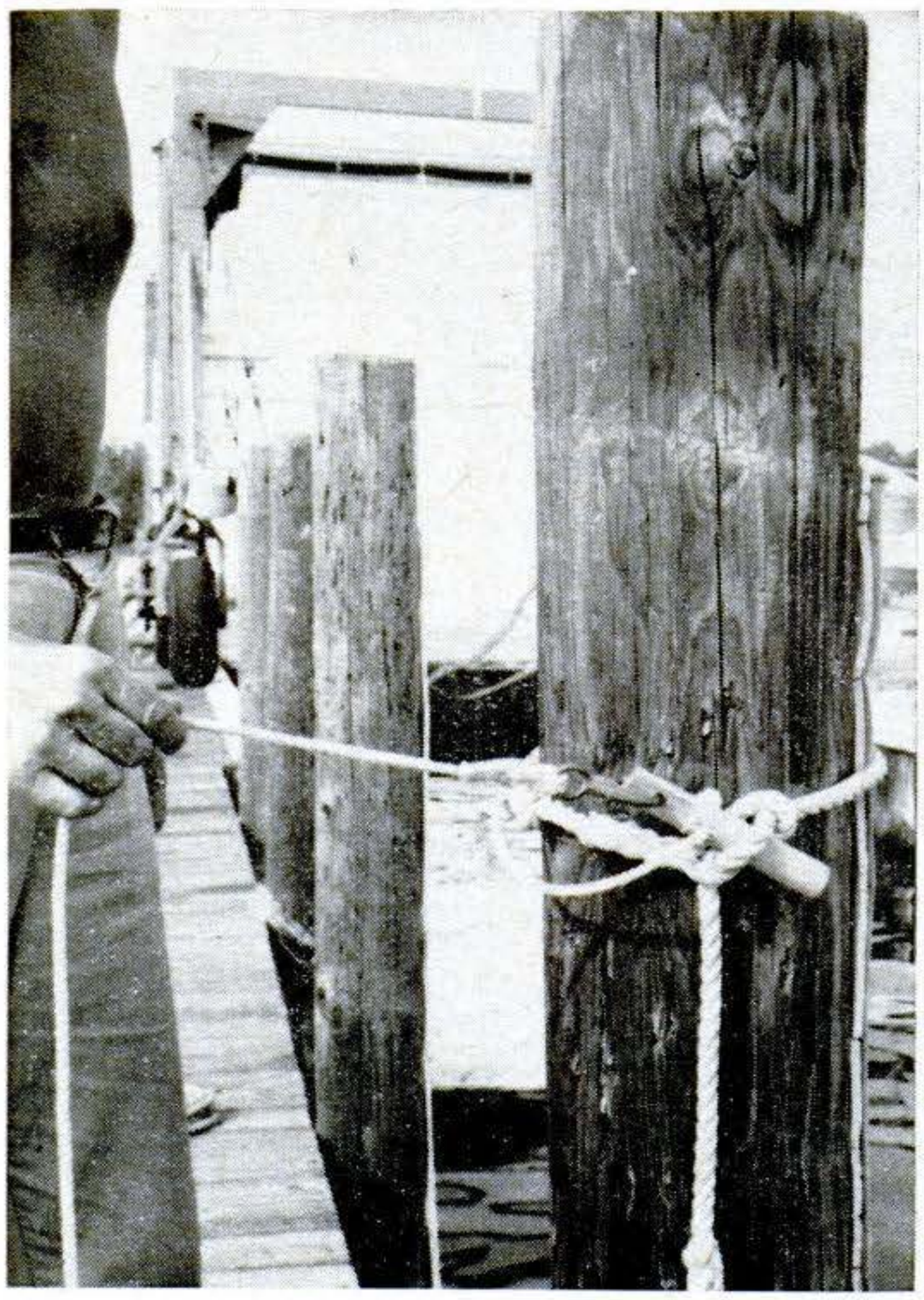
The main tank is permanently mounted in the boat, properly grounded and vented. It is equipped with a deck filler, positioned so that spillage goes overboard. If you're not using static-conducting hose, be sure you have a paint-free connection between the deck plate and the ground wire leading to the tank. The tank is connected to a through-hull fitting mounted below the waterline. All tanks should be in mounting cradles that keep them clear of the floor, for ventilation.

Set up your mounting cradles loosely before you start drilling. Make sure you have enough clearance, and that structural parts of the hull won't interfere with your work. Use bolts, rather than screws, whenever possible. Don't skimp on hose clamps —doubling up, especially on the bigger connections, gives you a safety margin. Snug them up tight so that no gas fumes can leak and settle in the bottom of the boat.



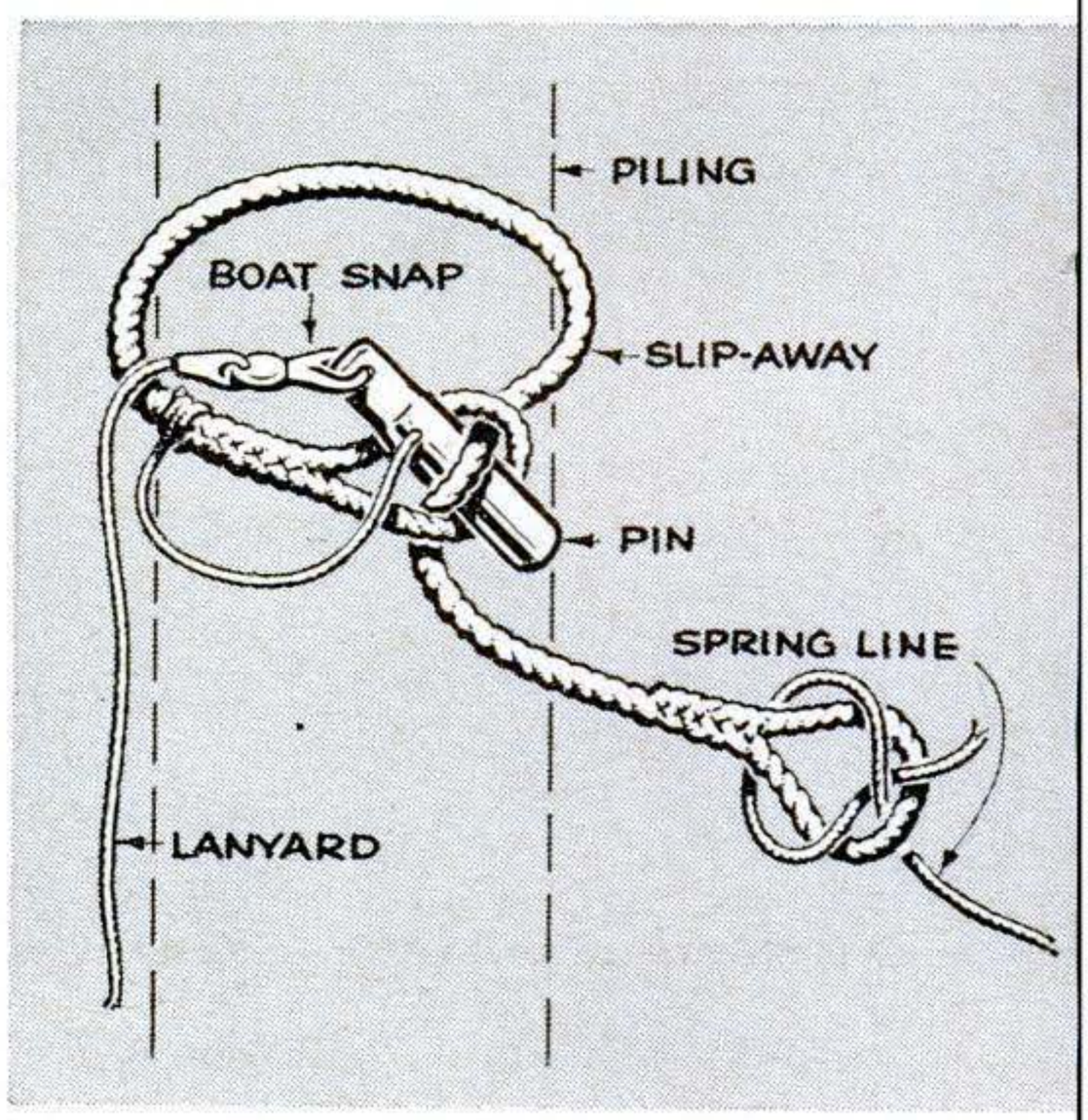
Wellnuts (above) are among the best devices for bolting tank cradles into a plywood floor over an air compartment. These consist of a tapped sleeve inside a neoprene collar. As the bolt is tightened, the neoprene expands and restores airtightness.

The Slip-Away—Six Feet of Nylon Gets You



Slip-away looks like this when your boat is moored. The spring line is fastened securely. The pin-pulling lanyard need not be snapped onto the pin until you're ready to get under way.

If you've ever tried to get out of a jammed-up mooring with not a soul in sight to give you a hand, here's a wrinkle you'll appreciate. It makes for a snappy-looking bit of boat-handling, too.



Elements of the slip-away assembly are shown here: spring line, slip-away, and pin-pulling lanyard. Tie your spring line to the large eye of the slip-away—a sheet bend works nicely for this.

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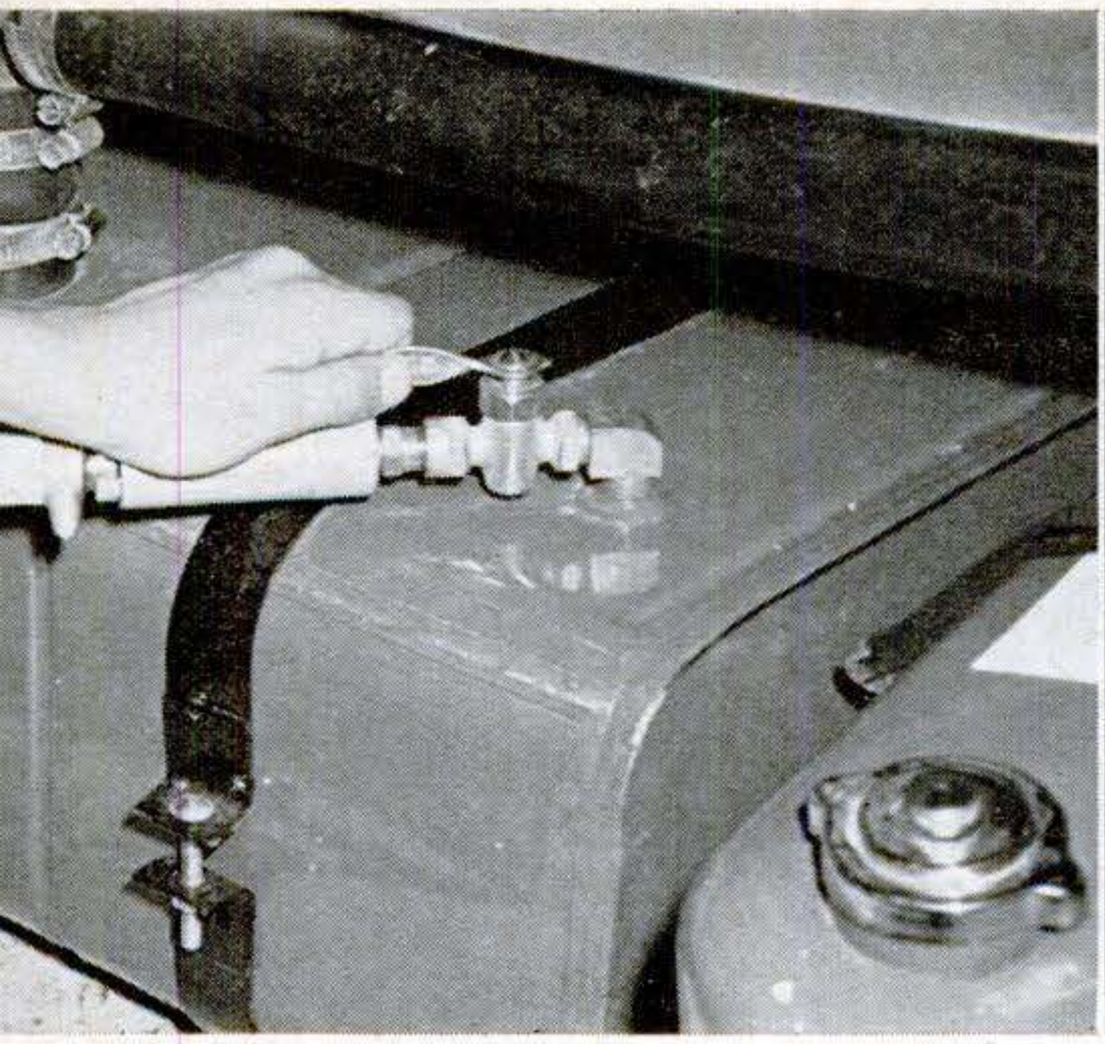
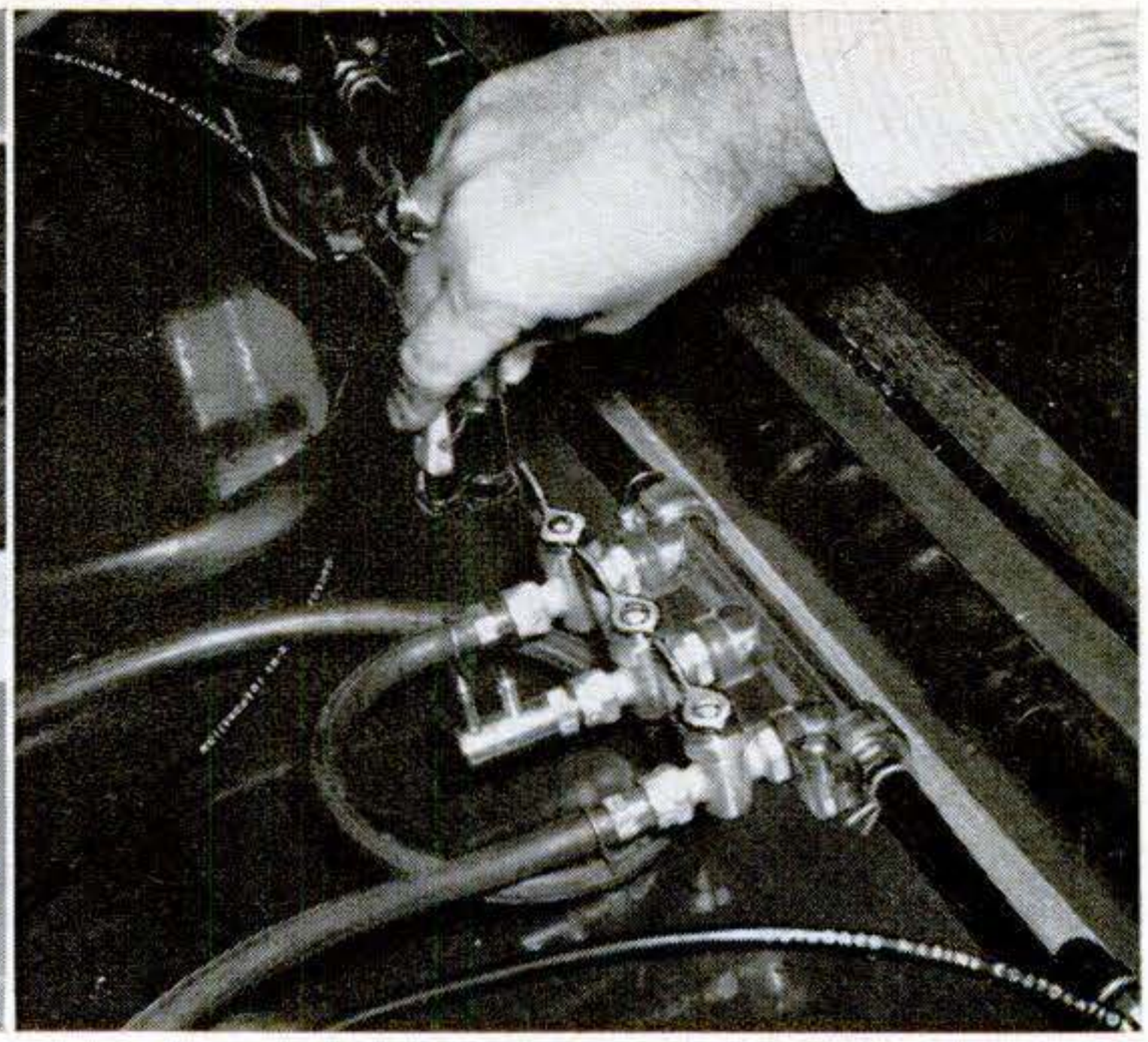


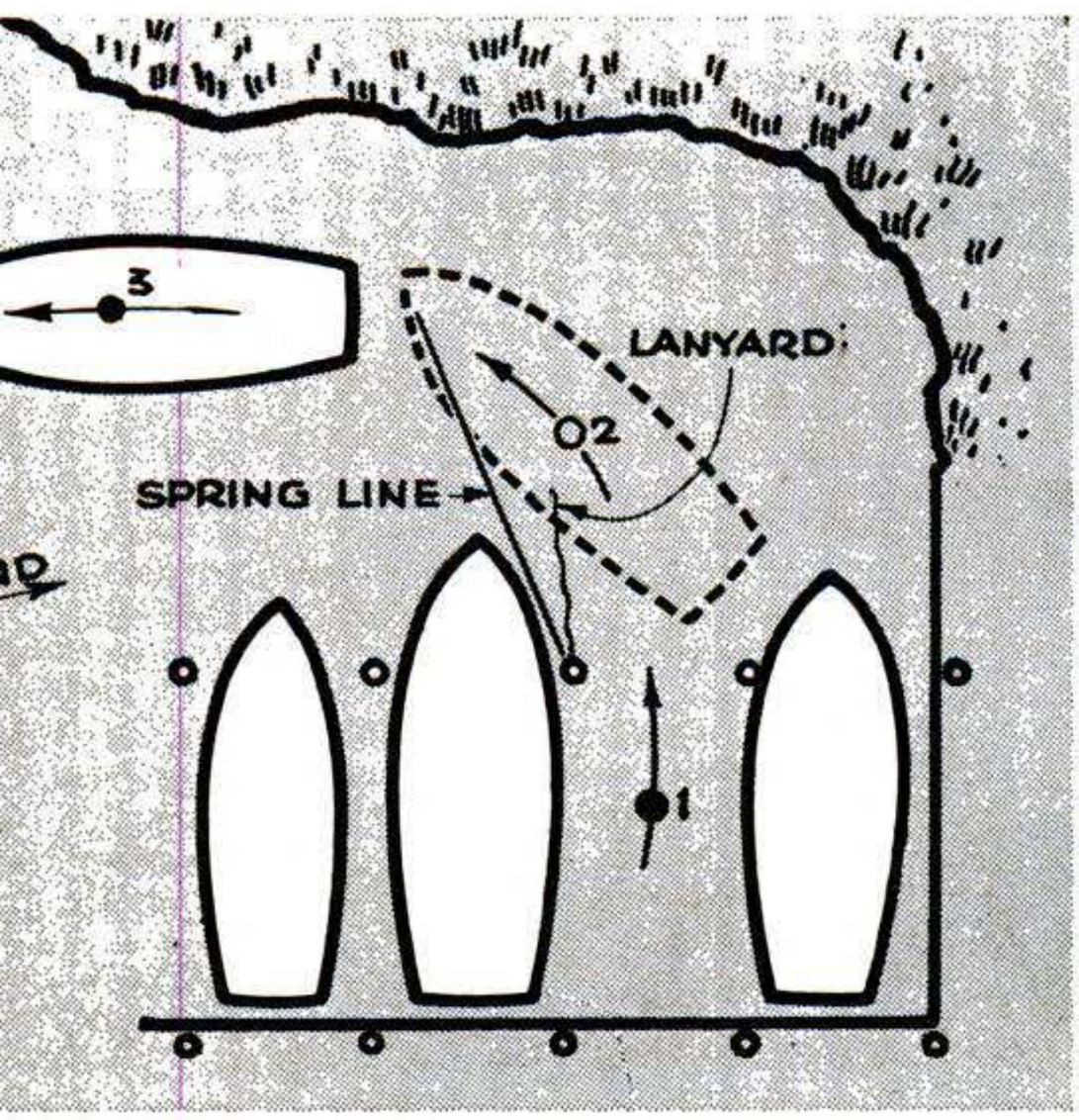
Cutoff valve on permanent tank prevents fuel from siphoning into boat if a hose should fail. Note the quick connector, which permits the hose to be changed from one tank to another in seconds. **One of the portable tanks can be seen at right.**



A useful accessory is this multiple-tank fuel-flow control, which permits all the tanks to be hooked up centrally. It provides safe split-second switching of tanks without spilling fuel and allows you **to see the flow. It is made by Tempo Products.**

Out of Tricky Moorings Single-Handed

I call it the "slip-away," and the heart of it is a six-foot length of ¾-inch nylon line. In one end you splice an eye just large enough to accommodate the doubled line. Splice a larger eye in the other end. The size is not critical, just so it is big enough to let you tie a variety of knots to it.



How to use the slip-away: 1) Apply power, paying out spring line and lanyard. 2) Snub the spring to restrain bow. Boat pivots with aid of rudder. 3) Clear away—haul lines aboard.

Just below the smaller eye, secure a pin made from one-inch dowel. The pin should be drilled and relieved at one end for a one-inch boat snap. Drill it also for a ¼-inch pin-securing line (see drawing).

Here's how it works. When you tie up, pass the slip-away around a piling or other dock member, pull a bight through the small eye, and secure it with the pin. Then attach your spring line (this should be manila, not nylon, for less give) to the large eye of the slip-away. Finally, the boat snap, to which is tied a 100-foot lanyard of ¼-inch nylon, is snapped to the pin.

When you're ready to leave your mooring, proceed under low power, paying out spring line and lanyard together. When you reach the point where you want to swing your stern around, snub the spring. When the stern is where you want it, reduce speed.

Slowing down slackens the spring line, allowing you to give the lanyard a tug to remove the pin securing the slip-away. The spring line comes free, and you simply haul in both spring line and lanyard, and go on your way.—*F. W. Fleischhauer.*

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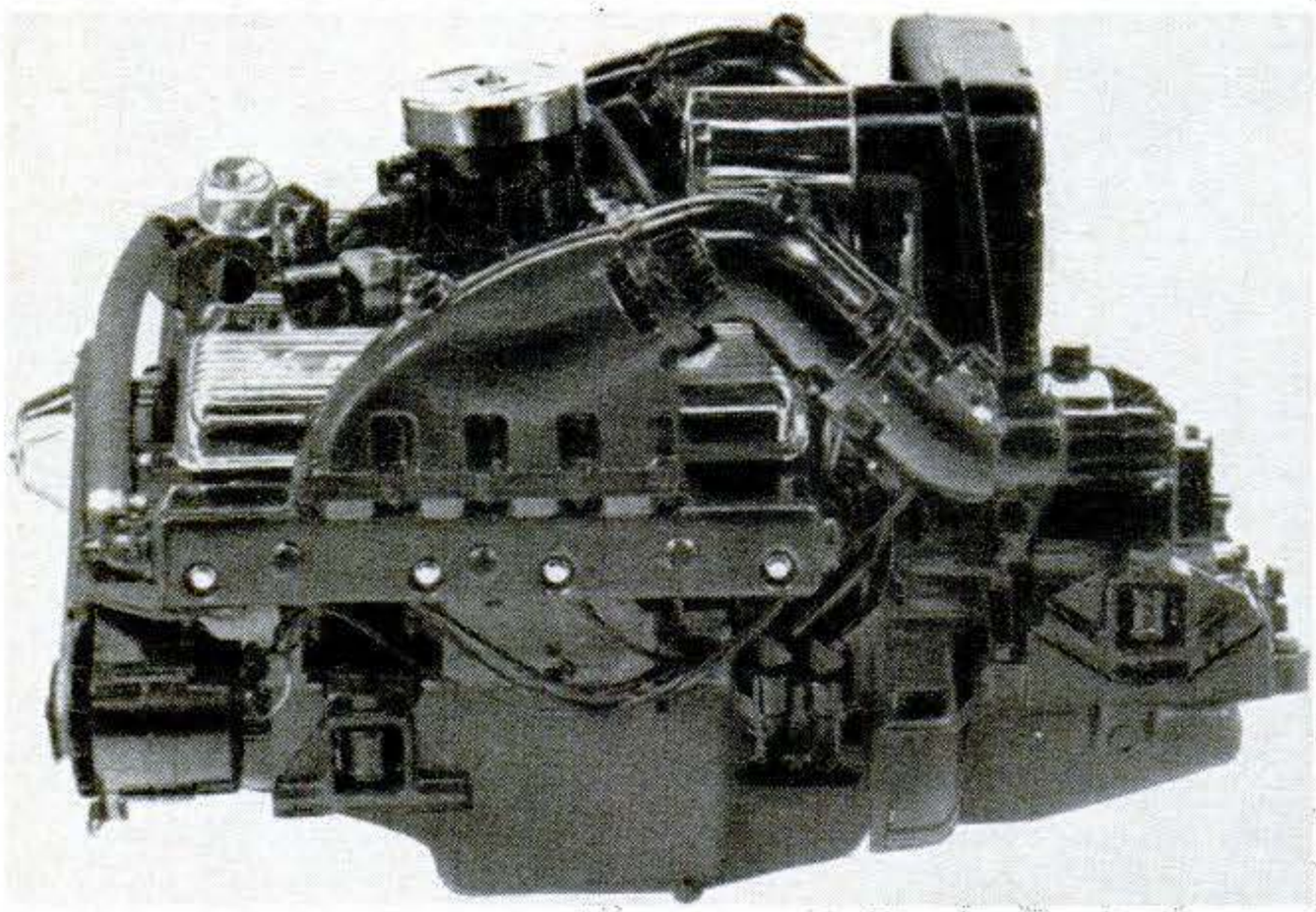
A see-through, sinkproof boat

You can locate fish and watch them bite, figure out how best to free a snagged anchor, or just plain sight-see with this nine-foot transparent-bottomed boat. The hull is made from ¼-inch high-impact plastic. Foam flotation is installed under the entire deck. With a 9-10-horse motor, the Glasshopper planes at 20 m.p.h. It will run under power when entirely flooded. Submernautics, 2200 South Blvd., Charlotte, N.C., is the maker of the 125-pound boat.



New line of marine inboards

Four-cylinder sailboat auxiliaries, V-8s, and V-6 diesels are announced by Kiekhaefer in their new inboard line, ranging from 25 to 325 hp. The V-8 shown here is available in either 225 or 325 hp. It is equipped with a capacitor-discharge ignition system, which does away with breaker points and attendant problems of adjustment and corrosion. Limited-production high-performance engines for high-speed and competitive craft are also offered.

Pushbutton marine radio

A range of up to 25 miles over water is claimed for this two-way Citizens Band radio from Raytheon. Nine crystal-controlled channels can be selected by pushbuttons, and any of the 23 channels may be monitored by switching the receiver to the tunable position. The radio can tolerate wide swings in supply voltage, a common malady on small craft. The price is $169.95.

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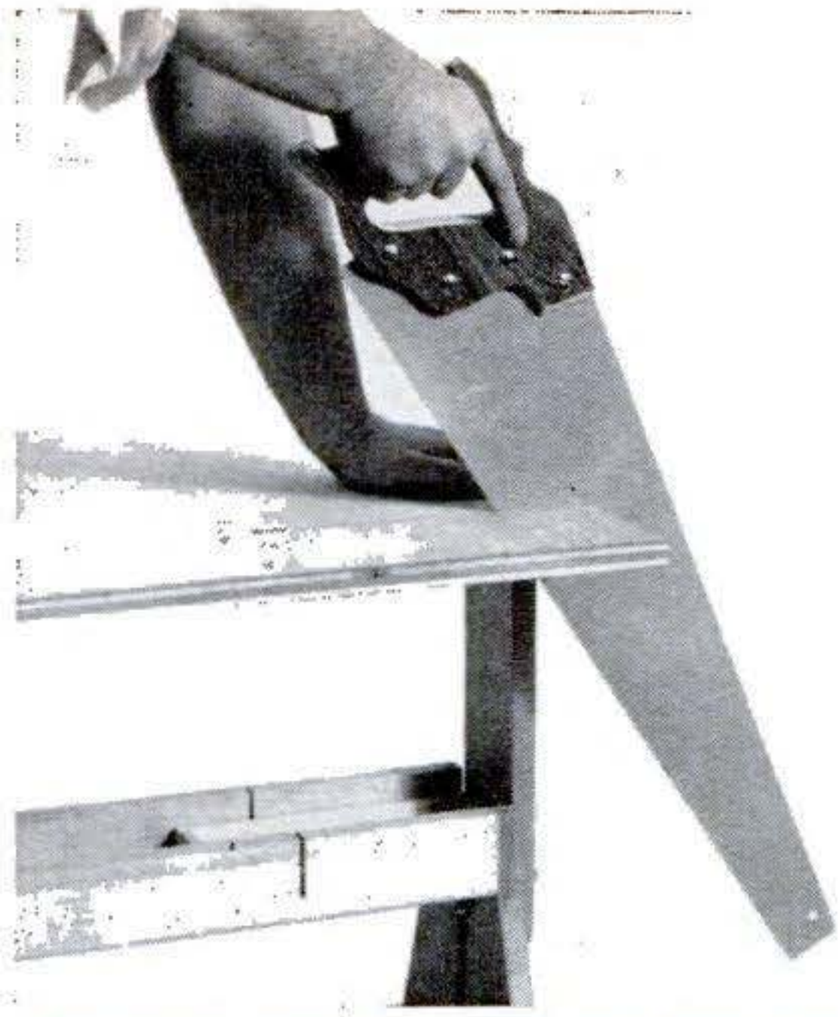
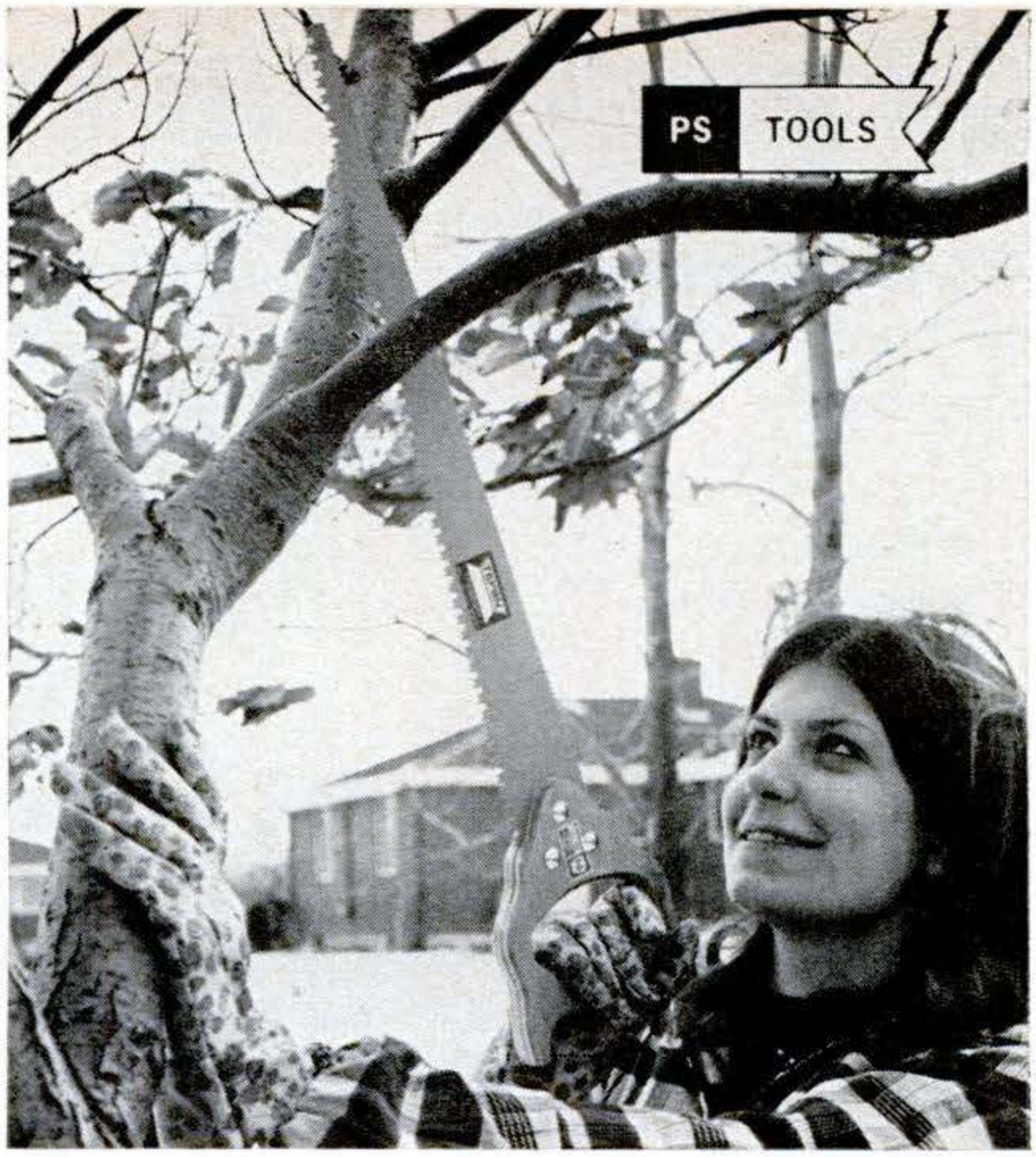


Handsaws won't bind even on hard-to-cut plywood panels. Nothing sticks to the coating, so the saw remains clean after use. It has life-long protection against rust.

Pruning saws coated with Teflon S don't clog up with sticky sap or wood resins. The slippery coating cuts drag and lets you zip through green wood with ease.



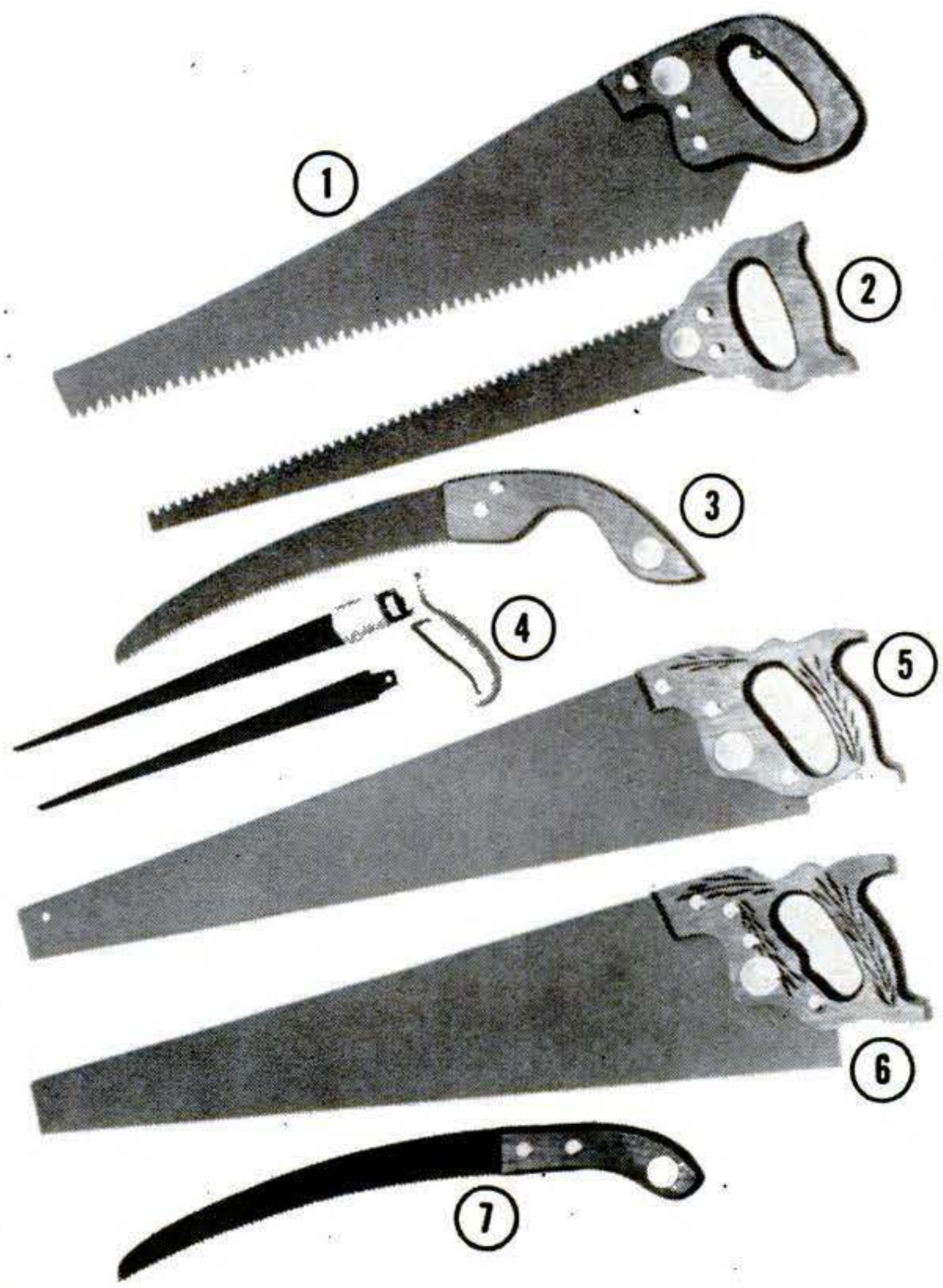
Teflon-Coated Saw: the slickest yet

New Disston Satin Slide saws slip right through cuts that jam other saws. Even wet sappy wood, plywood, and other hard-to-cut materials won't bind them. They also make normal cuts with less effort. A baked-on Teflon coating makes the blade slippery. It prevents rust; keeps the saw clean.

The new Teflon S coating, for industrial uses, is about three times harder than the Teflon used on cookware. Tests show that the coating does not wear off in normal woodcutting. Even if it's severely scratched, enough stays in the grain of the steel to reduce friction. Teeth can be reset or sharpened without affecting the sliding action.

There are nine models with the coating. They include a 26″, eight-point, all-purpose crosscut saw ($8.95); a professional-quality saw ($12.50); a light pruning saw ($3.99); and a 24″ professional pruning saw ($9.95).

New line of coated Disston saws shown below includes: 1) professional pruning saw; 2) double-edge pruning saw; 3) folding pruning saw; 4) combination saw kit; 5) all-purpose crosscut handsaw; 6) professional handsaw; 7) lightweight pruning saw.



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GADGETS FOR YOUR STEREO

To find out, PS bought a shelf full and tested them. Here are the facts

By RONALD M. BENREY
PS Electronics Editor

If you've ever doubted that listening to good music at home is as much of a hobby as it is a pleasure, just cast an eye at the assortment of hi-fi accessories that POPULAR SCIENCE has assembled on these pages. We bought them to find out if these gadgets really can improve the sound you hear. Here's what we learned:

Record cleaners. A minute speck of dust looks like a huge boulder to the tiny stylus in your stereo cartridge. Every time the stylus hits a dust speck as it races through a dirty record's groove, the cartridge generates an output voltage spike that produces crackle and pop.

A record attracts dust because of static electricity that builds up on its vinyl surface as it is played and handled. Once dust particles are deep inside the grooves, it's almost impossible to remove them with an ordinary brush or cloth—you must use a specially designed cleaner.

The three cleaners we tested—the Hush Brush, the Dust Bug, and the Record Preener—all helped to reduce the build-up of static electricity by drawing it off with a moist plush pad. But the sharp-bristled brushes on the Dust Bug and Hush Brush were the most effective in cleaning dusty records. We rate the Hush Brush as the most convenient to use because its built-in reservoir holds a considerable supply of antistatic fluid; the plush pads of the other two must be moistened before each use.

Turntable strobe. If your record player turns too fast or too slow, the music you hear will be off pitch. A strobe light and calibrated strobe disk let you detect—and monitor—turntable speed error.

The strobe we bought was nothing more than an AC-powered neon-bulb pilot light built into a handle. The bulb flickers on

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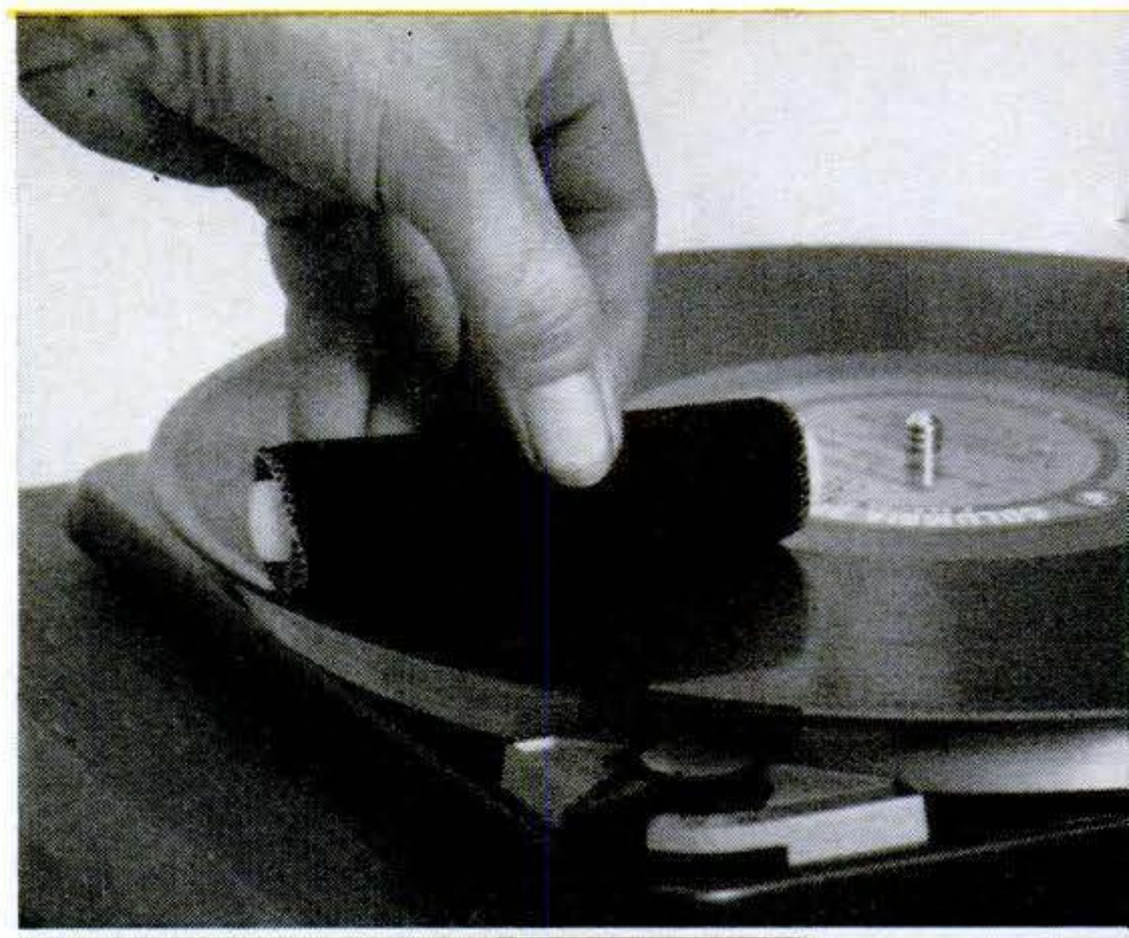

Record Preener (top) is a plush roller wrapped around a perforated plastic vial that contains a moist foam wick. The damp plush cleans off surface dirt like a sponge, but we found that it can't reach dust deep in the groove. Cost is about $4.

Strobe light and strobe disk are made by several manufacturers; our pair cost about $2. In operation, the flickering neon strobe light "freezes" the motion of one of the three striped speed bands on the disk if the turntable's speed is dead accurate.

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Are They Any Good?

Bug (lower photo, left) costs $6, and mounts
sa second tone arm. The dust brush in its tip
s across the record like a stylus, wiping the
ve as the record turns. The plush pad behind
brush transfers antistatic fluid to the record.

Hush Brush (above) cleans a whole record in one pass. You hold it in place on the spinning record for a few seconds, and the brush in the gadget's leading edge sweeps the groove clean; a damp rear-edge plush pad removes static electricity. It's $6.

mce-type stylus-force gauge costs under $1. To
it you shift the position of the counterweight
it balances the weight of the tone arm. Other
es of this kind have two or more different
hts so you can measure in fractions of a gram.

Spring-type gauge has a coil-spring mechanism that counteracts the downward pull of the tone arm. You turn the knob until the pointer inside the top window centers itself, and then read the stylus force from a calibrated dial under the pointer. It costs $3.

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and off 120 times a second—in step with the positive and negative voltage peaks in each cycle of alternating current.

The three bands of alternating black-and-white segments—one band each for 33, 45, and 78 r.p.m.—on the strobe disk are designed so the corresponding band appears to stand still, when viewed under the strobe light, if the turntable speed is right.

Unless you can recognize perfect pitch, small speed errors probably won't bother you. Large errors that everyone can hear signal that it's time to call a repairman. Consequently, you don't need a strobe light and disk—unless your turntable has a speed-adjustment control.

Stylus-force gauges. If your stereo cartridge rests too heavily on a spinning record, the stylus will wear the grooves unnecessarily. If it rests too lightly, the stylus will not track through the groove properly: The wide groove excursions found during loud passages will jolt the stylus in and out of the groove, producing a buzzing sound.

In between, there is a range of optimum stylus forces. To learn what it is, write to the manufacturer of your stereo cartridge.

The only practical way to set your record player's tone arm to this optimum force is with the aid of a stylus-force gauge. We tested two types: a spring-scale gauge made by Garrard and a balance-type made by Audiotex. Both proved equally accurate.

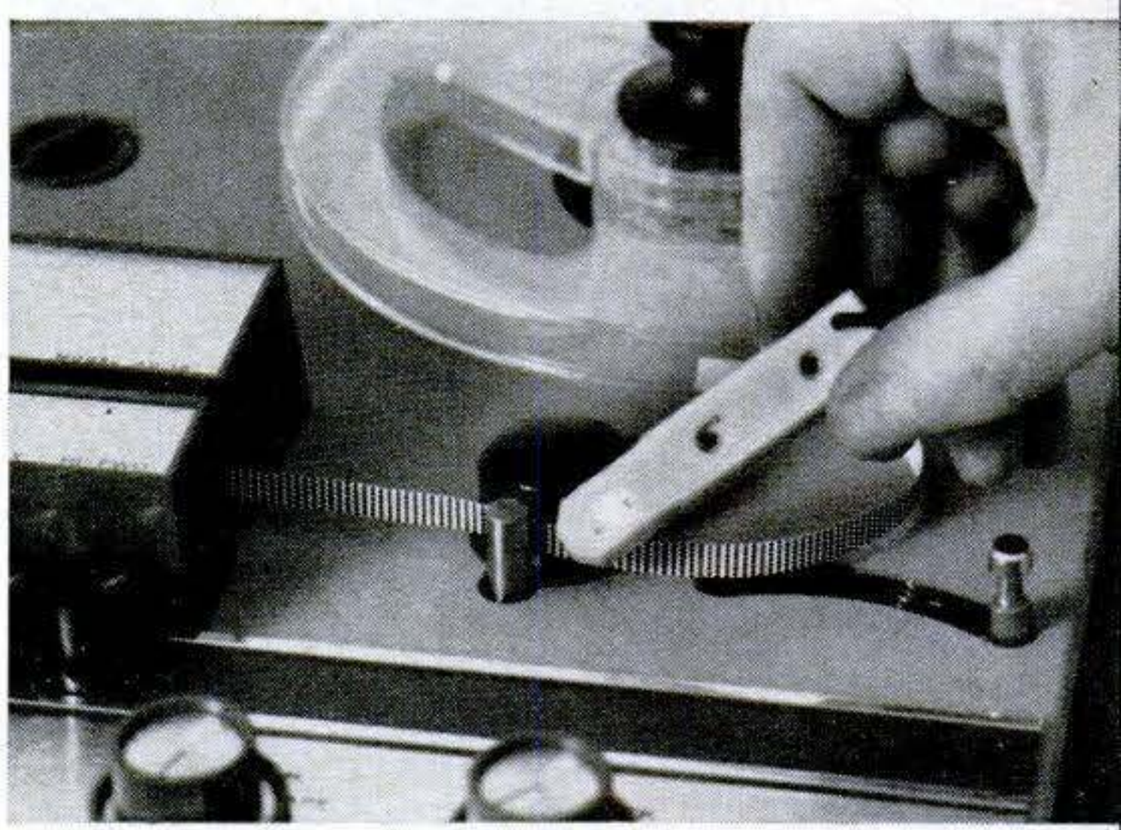
Tape-recorder strobe. We purchased two kinds—tape and wheel. Both must be used with a strobe light. Sure they work—but: The speed at which your tape recorder's drive motor pulls tape past its magnetic heads is important only if you play prerecorded tapes. Any deviation from a nominal 7½ or 3¾ inches per second (the speeds at which commercial tapes are recorded) will show up as a pitch error.

You won't detect an error on your own recordings, though, since they are recorded and played back at the same speed on the same tape machine.

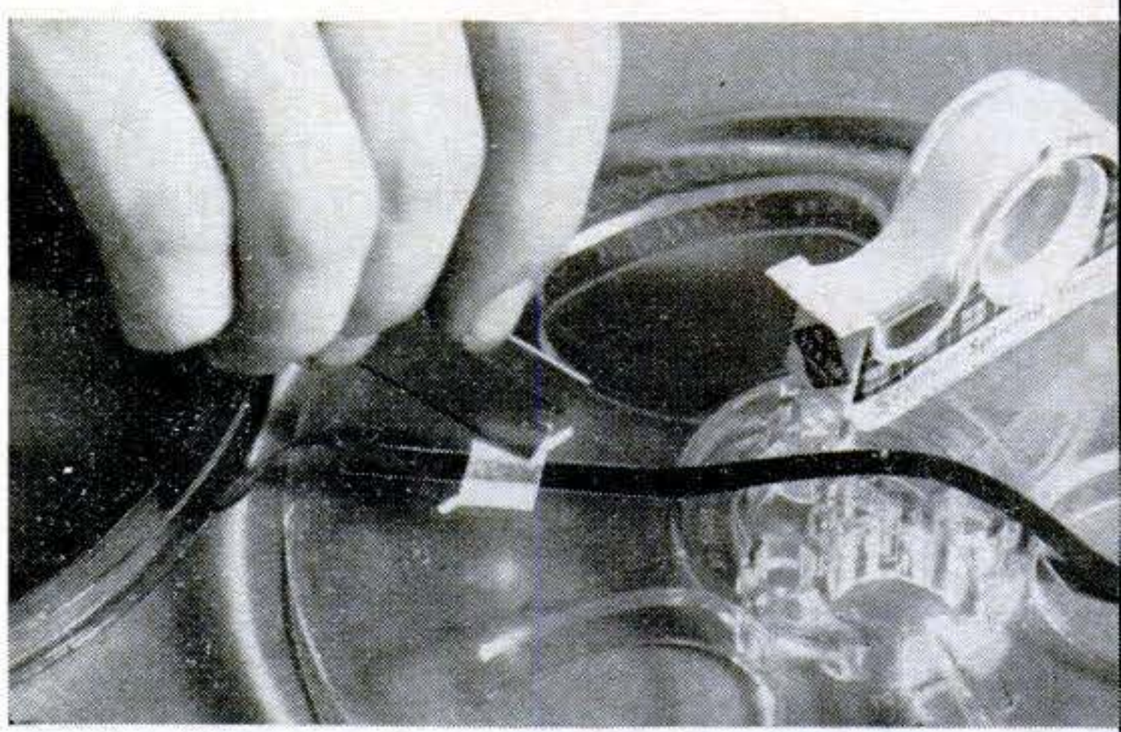
Bulk tape eraser. The erase head in your tape recorder just isn't capable of reducing the signal and noise content of prior-used tape down to the levels found on virgin tape—but a bulk tape eraser is. Our eraser was essentially a heavy AC-powered electromagnet that produces a powerful, large-coverage, alternating magnetic field. A few seconds exposure made our prerecorded

[Continued on page 225]

Strobe wheel for tape recorders is a rubber-rimmed disk mounted in a metal yoke. You place it next to the tape path on your recorder so the moving tape spins the wheel. If the stripes stand still under a strobe light, speed is okay. Our wheel cost $5.



Strobe tape for recorders is a length of paper tape printed with a black-and-white strobe pattern. You observe the tape under a strobe light as it is propelled forward by the recorder's capstan drive. Our tape cost under $1; it was made by Audiotex.



Splicing jig molded into the flanges on both sides of Kodak seven-inch tape reels is simple but perfectly adequate. Add a dispenser of splicing tape and a single-edge razor blade to trim the splice, and you can handle most emergency splicing jobs.

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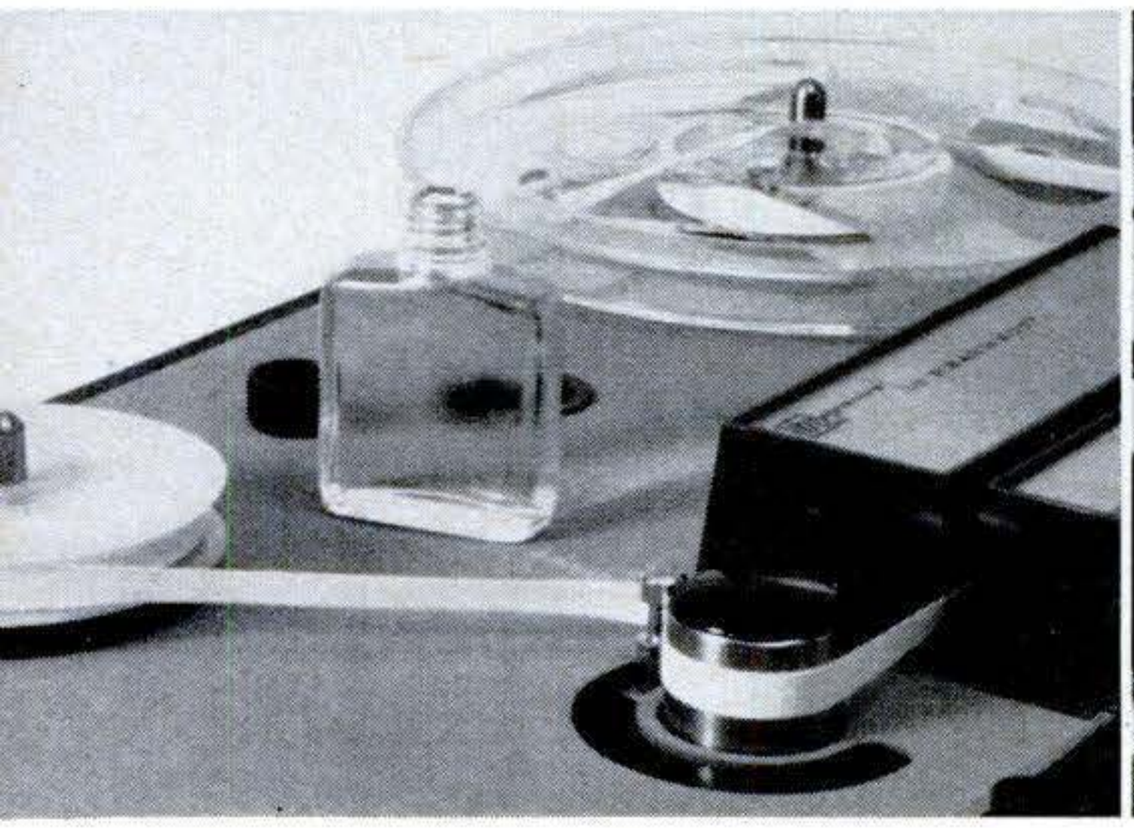
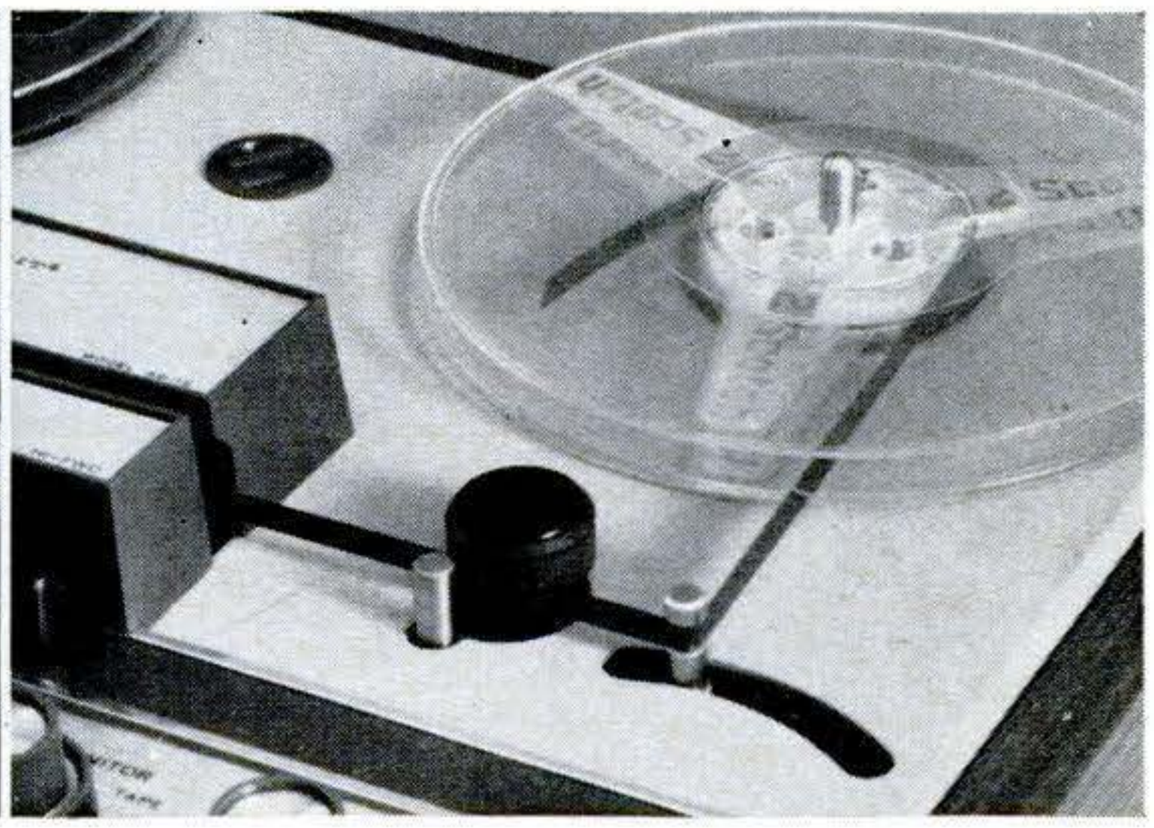
Bulk tape eraser is a $20 investment, but it's worth it if you record on previously used tapes. To operate it, place the reel on the eraser's spindle, and rotate it a few times. Then slowly bring the reel away from the eraser. Our unit was from Microtran.

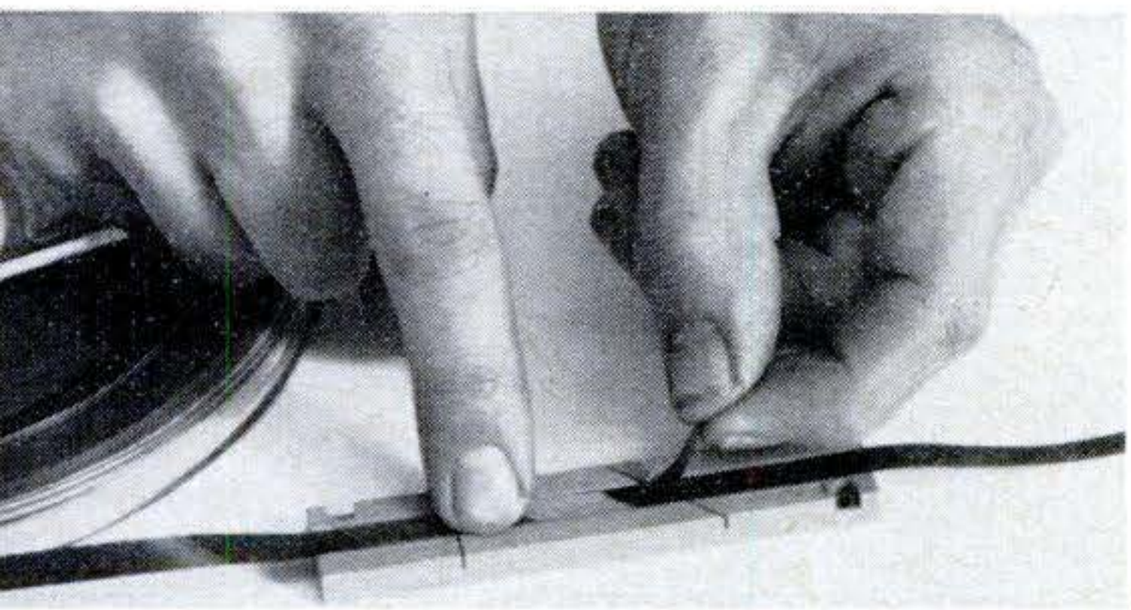
Head demagnetizer is so easy to use it makes sense to give your valuable prerecorded tapes the protection it offers them from hiss buildup: Just bring the gadget's prod up to each head and draw away slowly. We bought a Hed-Demag unit that cost $6.

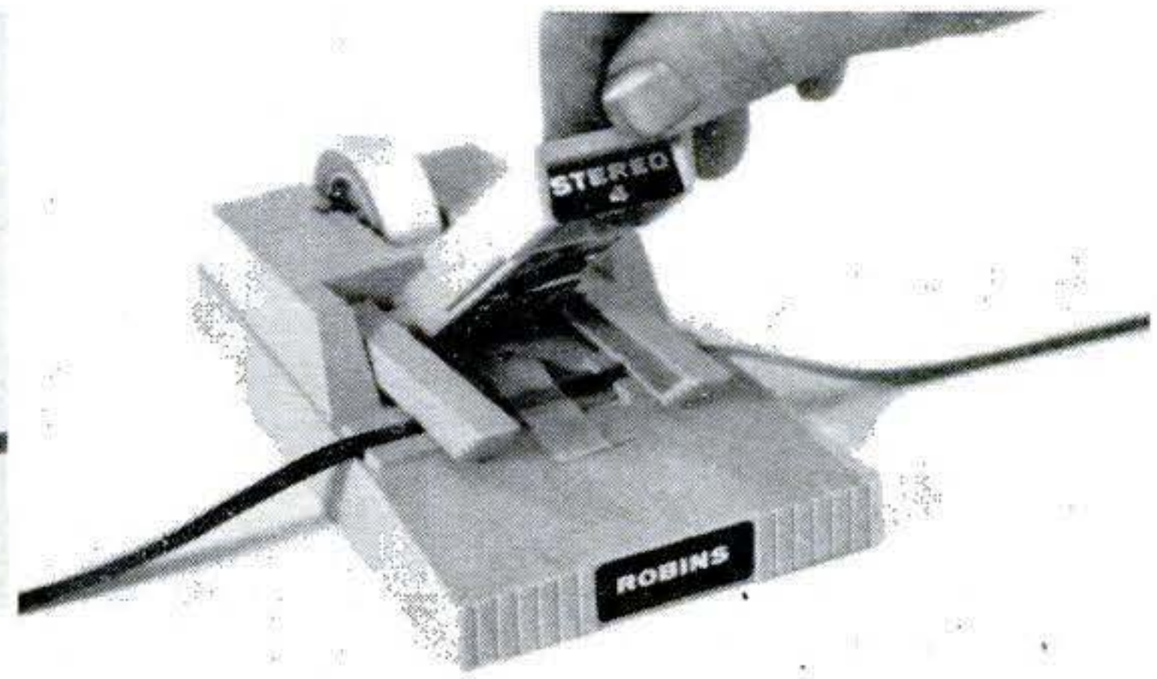




Head-cleaning kit, made by Robins, consists of a reel of ¼-inch cloth tape and a bottle of cleaner solution. You dampen the tape by dripping solution through ports in the reel's flanges. Then you run the tape through your recorder. Cost: $2.

Self-threading reel, made by Scotch, has three metal grippers spaced around the hub that grab the tape leader as you pass it through the flanges. The grabbing action was a bit unreliable when the reel was used on vertically mounted decks. It costs $1.





Edit-All splicing kit includes an unusual block that grips the tape ends in a lipped groove. After trimming the ends and butting them against each other in the groove, you apply a precut and shaped tape splice that joins the ends. The kit costs $4.

Gibson Girl splicing machine gets its name from a set of built-in trimming blades that give the finished splice an hourglass shape. This prevents the tape adhesive from oozing out of the splice onto other parts of the tape or reel. Cost: $10.

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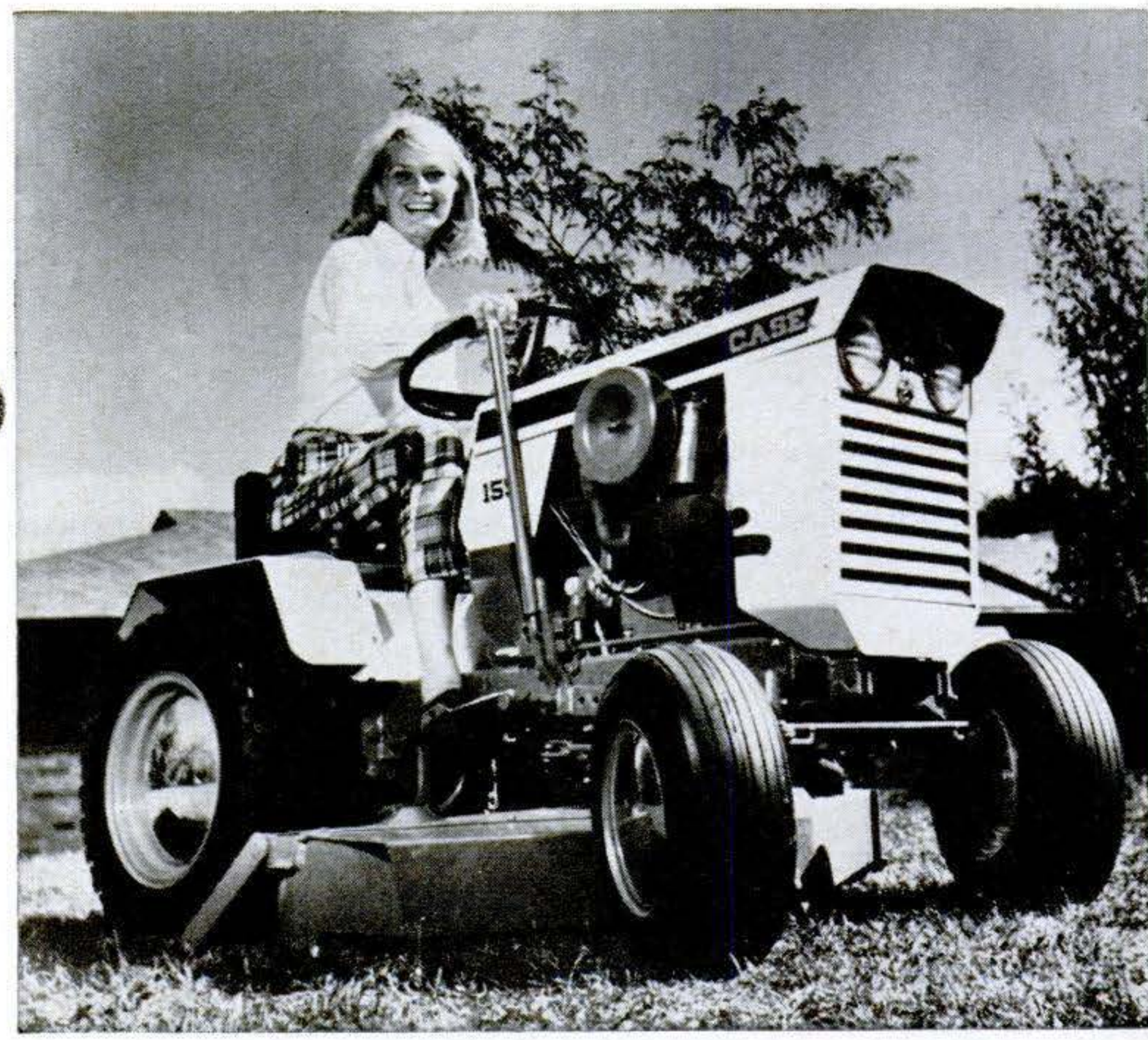
Riding Mower or Tracto



The minimum riding mower above, available from Montgomery Ward for less than $100, lets you sit down to mow on level lawns. You can also ride to mow (and do many other things) on a 10-hp. Case tractor (right) equipped with hydrostatic transmission. Some people can be happy with a rider; some need a tractor for the many chores they must do.

For around $100 you can buy a machine to *ride on* as you mow your lawn. An engine of three or 3½ hp. will propel it. You can also buy a rig that lets you ride as you mow but that will cost you $700 and up for its 10 hp. or more.

The first outfit obviously is a riding mower. The second couldn't be anything but a home-size tractor. Does horsepower make the difference? Not altogether, even though 3½ hp. is far too small for tractoring and 10 hp.—or a smaller tractor at as low as seven hp.—is more than you need for mowing alone.

Looking into the entire field of yard power early this year, I found that the industry itself has never established a clear line between riding mowers and tractors you can use to mow lawns. But conversations with many manufacturers—some who make tractors, some who make both—produced the following working definition:

If the rig you buy has a mowing head as standard equipment, it's a mower. If what you buy is a source of power for a completely separate mowing head and other attachments, it's pretty safe to call it a tractor.

With this as a line of demarcation, POPULAR SCIENCE this month brings you up to date on both riding mowers (in the remainder of this article) and (beginning on page 148) home tractors.

Extra jobs for riding mowers. Accessories are available for some of the larger riding mowers. A lawn roller, sweeper, fertilizer spreader, aerator, and cart are a typical list. At about six hp. you also may be offered a snow/dozer blade or a snowthrower. But other accessories—for instance, a plow or cultivator—usually demand the greater horsepower of a full-fledged tractor of 10 hp. or up.

Pick the features you need. You may want just basic machinery, or you may want some conveniences, or faster action. Here are some figures that show what you get for your money, taken from a typical riding-mower line:

$349.95. You get five hp., 26-inch cut. You can mow about one acre an hour. For $434.95, you get electric battery starting.

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..Which for You?

By JACKSON HAND

$414.95. A six-hp., 30-inch mower. You mow about an acre and a half an hour. Electric starting for $499.95.

$649.95. Buys you eight hp. and 41-inch cut. You do two acres an hour. Electric starting for $764.95.

Here's another set of figures, all for a 25-inch mower:

$250. Four hp., forward, neutral, and reverse.

$350. Five hp., two speeds forward, two reverse, padded seat.

$450. Six hp., a backrest, higher hood, front fenders.

Although you'll find relatively small difference in prices for equal quality and features from manufacturer to manufacturer, within any one line you'll find important differences, feature to feature.

Chassis. As you shop, you'll find some radical ideas—some new, some refinements—in the way riding mowers are slung together:

The pan chassis as typified by Reo is a single stamping with the engine and operator cradled in a safe and comfortable skiff-like tub, with the wheels, blade, and other contrivances either outboard or below decks. The controls come up through holes in the stamping.

Channeled chassis, like that on Jacobsen's models this year, incorporate a rugged steel channel perhaps eight inches deep and 10 inches wide to carry running gear, blade, and controls.

The "reach" design of the old farm wagon, as used by Ariens and others, has a driving rear end, a steering front end, and a cutting middle, all strung on a heavy steel pole.

The frame chassis continues as most numerous, but you'll find it beefed up, with an increasing number of front axles pivot-mounted so the rig will ride uneven ground without twisting the frame and without undue galloping.

Engines. There is a considerable trend toward rear-mounted engines, and the advantages cited include:

- Better traction, with the engine weight over the wheels.
- Better drive linkage—direct to the drivers. Long belts are more suited to driving the blade than to driving the rig.
- Unshrouded construction, meaning better engine access and cooler performance.
- Better vision and better access to controls.

Another version of engine-over-drive-wheels is found in the Montgomery Ward

Continued

Tractor-style mower: Among smaller mowers in four-five-hp. range, dealers are showing basic machines such as this Bolens five-hp. Suburban 26. Differences may include ranges in cutting swath, speeds.

Straightforward design: New Ariens Fairway Deluxe 5 keeps price down by eliminating nonessentials. If you're a careful shopper, watch for the economy of business-only mowers, which most lines include.

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Sunbeam 25-inch super-deluxe rotary rider is powered by five-hp. gas engine. A tractor is also offered.

Bolens Lawn Keeper is the only riding mower with center-pivot steering and up-front seating.

Wagon-reach design in Yard-Man Mustang 25 (above) and Toro (below) is more and more popular.

Weight on rear wheels improves traction. Pivoted front axle lets cutter ride over turf without scalping.

and Yard-Man models. These have front-wheel drive and rear wheels that steer. The engine is over the front wheels, and the mowing head is mounted out in front.

Easy-pull starting. This is a feature of engines both by Briggs & Stratton and Tecumseh, all the more important with the higher horsepowers used on riders. Basically, easy-pull is due to a cam design that holds the exhaust valve open slightly until the engine is firing, thus eliminating much of the hard yank you would need to pull the engine through compression.

Although the drive mechanism on many riding mowers still may depend in part on chains or belts, there is a strong move toward automotive-type transmissions, differentials, and sealed-for-life gearboxes.

You can expect control over forward speed to give you a range from a slow crawl up to five m.p.h. Such speed variations are necessary to prevent a riding

A summary of riding mowers tha

Ariens. Line of riders from 4 to 6 hp. New this year is the 26" Fairway Deluxe 5. Ariens has chain drive, life-lube differential, engine in back. Mower pan is self-floated, unrelated to transport wheels so that it follows the ground contour.

Atlas. (Atlas Tool and Mfg. Co., 5147 Natural Bridge Ave., St. Louis.) Three new riders in 4-to-7-hp. range. Three forward speeds, one reverse. Differential. Height adjustable while mower is in motion.

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You get a handy tote box under the seat of this new four-hp. Atlas, two forward and two reverse speeds.

A five-hp. rotary like this neat Homko usually can pull such accessories as a roller, cart, or seeder.

mower from driving itself too rapidly into heavy grass and thus reducing blade speed below good cutting efficiency.

Overall performance. Riding mowers mow better than they used to. Better ratio of engine to blade size is one major reason why. Not long ago you could buy a riding mower with a given horsepower at just about your own choice of cutting widths. Obviously, there had to be a point at which the engine couldn't handle that swath.

Now they've settled down at a ratio pretty close to five hp. equals 25 inches. It varies up and down a little. For instance, a four-hp. engine will handle a 25-inch blade if it doesn't have a lot of excess weight to haul around—in other words, on an efficient machine. On the other hand, a 25-inch mower with a six-hp. engine will provide enough power to haul a fertilizer spreader or other light accessory while the machine is mowing.

Safety features. Riding mowers conform to the same standards as those the industry set up for self-propelled models—plus more. A deadman control of some sort is essential—usually offered in the form of a foot pedal. If you take your foot off, the rig stops. On one machine (Toro's Big Red) the seat is the deadman control.

Discharge chutes are longer for safety—while at the same time clearances on the other side of the blade housing let you come as close as ⅝ inch from obstructions. In some cases (Root, Baxter Springs, Kans., is an example) there is no chute; clippings are dropped out the rear, and, with rear axle, transmission, etc. to block its flight, there's little chance of debris being thrown.

For a report on home tractors, please turn the page

...u can buy this year from the major manufacturers

Bolens. Two sizes in a riding mower: 24" cut, 4-hp. model, and 26", 5-hp. model, both with low and wide design, gear transmission, auto-type differential. Top Bolens rider is the 6 hp. center-pivot Lawn Keeper.

Comet. (McDonough Bower Equipment, McDonough, Ga.) Rotaries in three sizes: 5 hp., 26" cut; 6 hp., 30" cut; 8 hp., 41" cut.

General Appliance. (6200 N. 16 St., Omaha, Neb.) Feature rider (Bonanza) is available in 5- and 7-hp. models, 28" and 32" cutters.

Gilson. Line of riders at four, five, six and seven hp. A novel idea is height adjustment through a "dial hubcap." You pull out the hubcap, turn it to 1", 2", or 3" marking and it raises or lowers the wheel.

Hahn-Eclipse. You can start the blade of the 5-hp. Pow-R-Boy 200 after you're safely seated on it. This rider cuts a 26" swath, has a five-speed transmission. A housing of special design holds grass up straight for even cutting.

[*Continued on page 218*]

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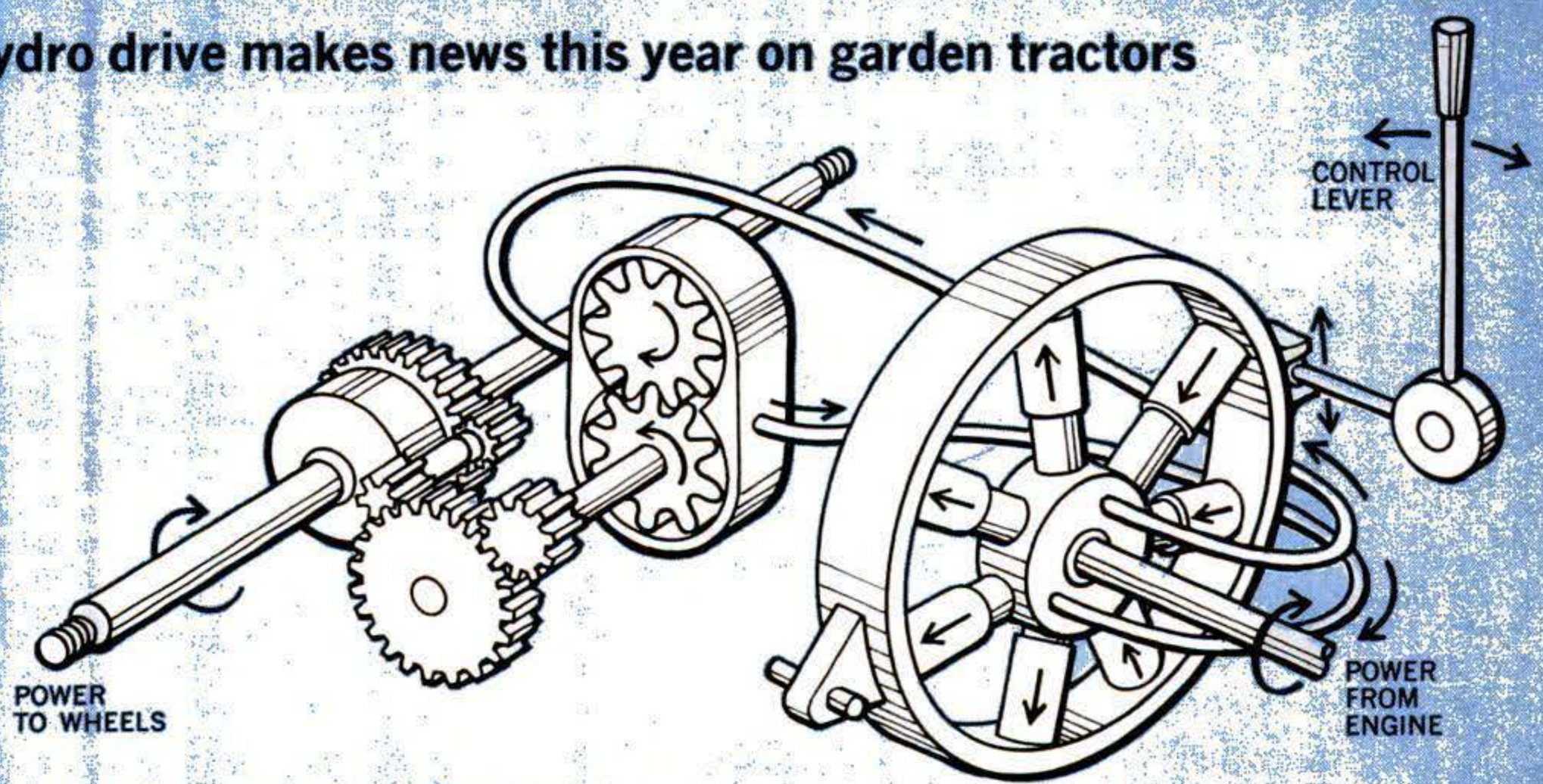
Hydro drive makes news this year on garden tractors



Hydraulic pump is the heart of a hydrostatic transmission now offered by at least half-a-dozen home-tractor makers. There are several versions, but all follow the principles illustrated in drawing above. The engine shaft turns a hydraulic pump inside a ring that's free to move as the tractor operator shifts a control stick forward or back—or pivots a foot control with his toe or heel. When the control is at neutral position, no oil moves through the sy tem. When you shove the speed stick forward depress the pedal, the ring moves to one side, a lowing the pump to force oil in one direction gears that drive the axle. The farther you move th stick forward, the more oil is pumped and the fast the tractor moves. Move the stick backward, ar the pump reverses flow—and the tractor backs u

Basic power is what you get in a tractor such as this 12-hp. Sears. Pick the accessories you need.

You get top performance from these new wheeled power plants—and you can do your yard and garden work faster

By JACKSON HAND

A Home

Three bits of news have combined to make this the best year yet to buy a home-size tractor:

- Many of the big names in agricultural and commercial tractors have moved deeper into the field, with models of 10 and less horsepower and big-tractor features.
- The better lawn-mower makers have moved up, putting seven, eight, and more horsepower into machines that do far more than mow.
- Basic improvements in home-tractor design are all over the place. Most important is the hydrostatic transmission, now being used on many home tractors of about 12 hp. In all power ranges, you now also find such engineering refinements as automotive-type transmissions, differentials, and

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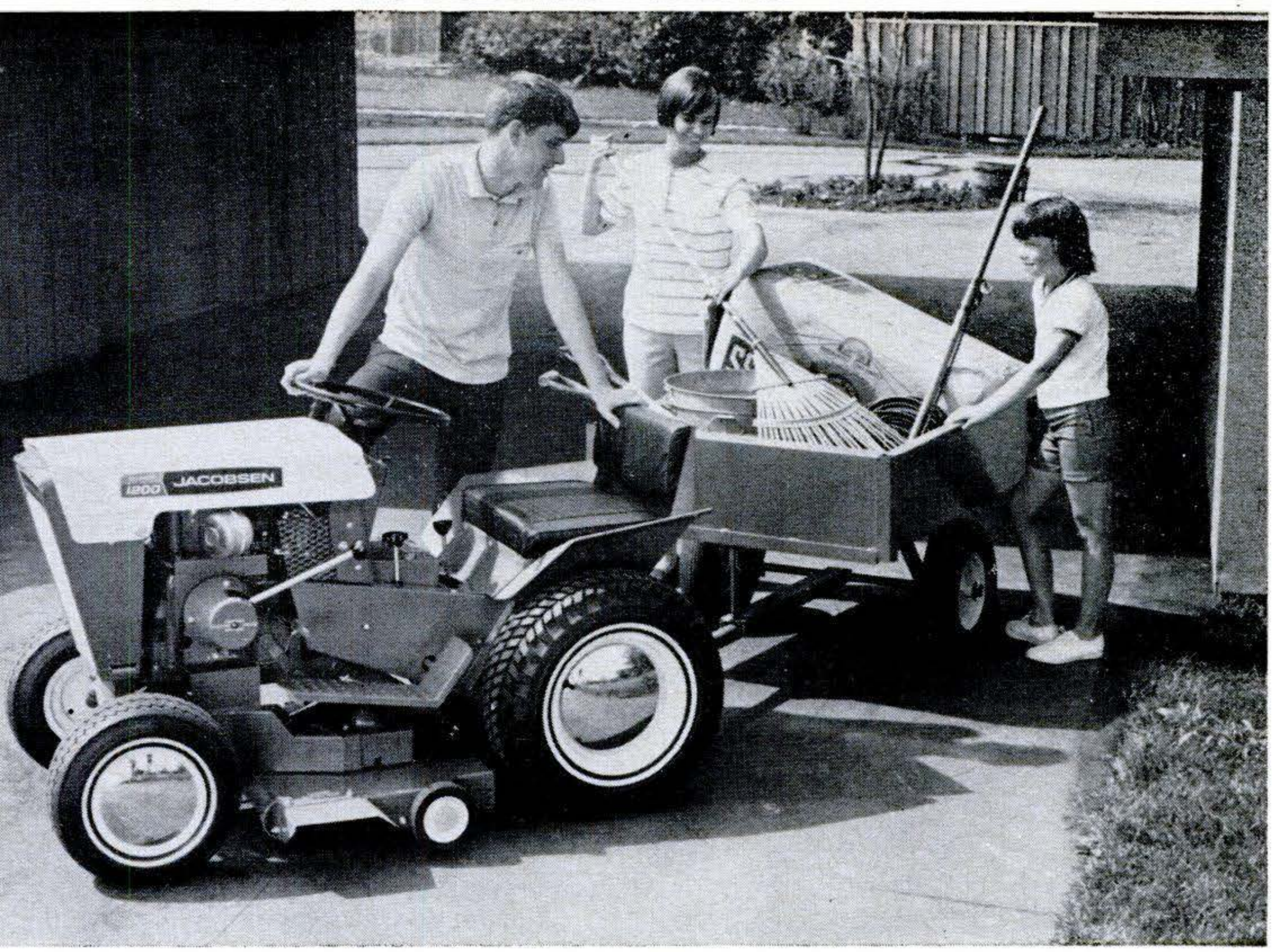

Tractor: Jack-of-All-Jobs

transaxles—transmissions combined with the driving axle.

Automatic transmissions. These come on some of the latest tractors made by Bolens, Case, International Harvester, Jacobsen, Pennsylvania, Wheel Horse, and others. There is no clutch. Speed range is infinite up to about eight m.p.h., three m.p.h. reverse. Neutral gives braking action.

In other new tractors, stick-shift transmissions (often transaxles) provide up to eight speeds forward. This yields a versatility in power that some makers contend compares well with the newer hydrostatics.

Engines. Starting ease and vibration control are two features of higher-powered engines. Kohler now lessens some of the compression at low r.p.m. by holding the exhaust valve slightly open. Centrifugal force automatically restores the compression when the engine revs up: When temperatures are low, starting is faster.

When one-cylinder engines get up to 10 hp. or more, there is a vibration problem. Briggs & Stratton licks it with a counterbalance system on the drive shaft to compensate for the weight of the crank and the piston assembly.

More and more units in upper power ranges have electric starting. You add about $70-$90 to the cost, but the compensations include lights and other refinements.

Two-wheel tractors. Despite a tendency to think of tractors as automobile-like machinery, two-wheel models continue in favor. Gravely, Ariens, Devere-Locke, and Simplicity are among the leading producers.

Basically, the two-wheel tractor is all power—an engine mounted on a pair of wheels that you can use to haul or push things. Power-takeoff systems activate such equipment as snowblowers, rotary mowers, and tillers.

Continued

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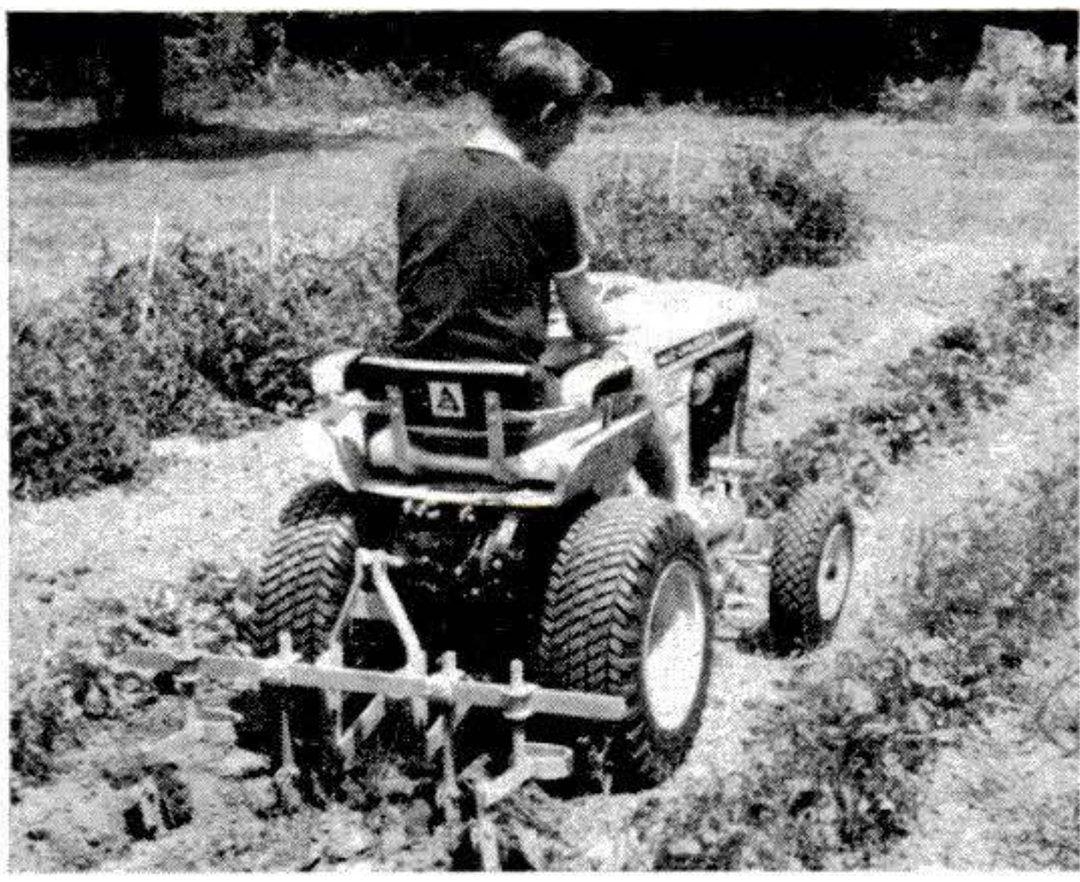

Cultivating a garden is one of many tractor jobs. This 12-hp. Allis-Chalmers has a crankshaft with two gear-driven counterweights to reduce vibration.

For weed cutting, or where mowing gets tough, you can quickly unhitch the riding sulky from Gravely and have all advantages of a two-wheel tractor.

Eight and 10 hp. are the top, normally, for two-wheelers, and that is all you need, in view of the efficiency. Low cost is an important factor, too.

A compact, slick version of the two-wheeler is the Bolens Estate Keeper, which has a power-drive unit with front-mounted riding sulky. It, like other sulkied two-wheelers, has a turning radius of just a few inches. Un-sulkied, a two-wheeler turns on one wheel.

What does your dollar buy? A 12-hp. tractor with good operating features costs about $1,000. For a comparable machine with 10 hp. you pay about $50 less. The drop to eight hp. cuts another $75 off. When you move down into seven- and six-hp. models, the break is bigger, because the manufacturer usually scales the entire rig down—as much as $150 or $200 less.

Looking at these figures (they're for a typical line) the economic facts are quickly apparent. Between seven and eight hp. the price differential is big. You need a *reason* to go into the bigger sizes. However, once you reach the upper ranges, a few dollars more buys more performance, and the choice may be a coin-flip's difference.

Another consideration is features. One manufacturer, who is typical, sells a fully equipped 10-hp. rig for $875. The same rig with only basic features goes for $750.

Key questions that you should ask yourself in the tractor-or-mower decision: What else will you do with it besides mow? How often will you want to drop the mower? How much tillage must you do by power? What accessories do you need now—and how many more might you want in the future?

Light yard work—hauling, seeding, fertilizing, sweeping—can be handled without dropping the mower provided the lift (hydraulic or lever) raises the pan high enough for clearance. When you need only this kind of service, the higher-horsepower tractors give you only extra speed.

Less than a third of all home-size trac-

What you can get: Here's a summary of home tractors

Most major manufacturers of home tractors are included in this list. However, some makers have limited distribution, and you may find other equipment for sale in your area.

Allis-Chalmers. Hp.: 12 and 10. Drive: direct, stick shift with optional high-low range providing eight speeds. Accessories: full line, including trenching saw, earth auger. Features: easy-spin, counter-balanced crankshaft; hydraulic lift; controlled-traction differential.

AMF (Homko). Hp.: 10. Drive: direct from gearshift transmission to drive shaft, full range from one to eight m.p.h. Accessories: full line. Features: no clutch, continuous engine speed, shift on the go; individual rear-wheel turning brakes; power takeoff (PTO) at rear; automotive steering.

Bolens. Hp.: 12½, 10, 8, 7. Drive: hydro on the 12½, geared transaxle with plate clutch on others. Accessories: standard line with

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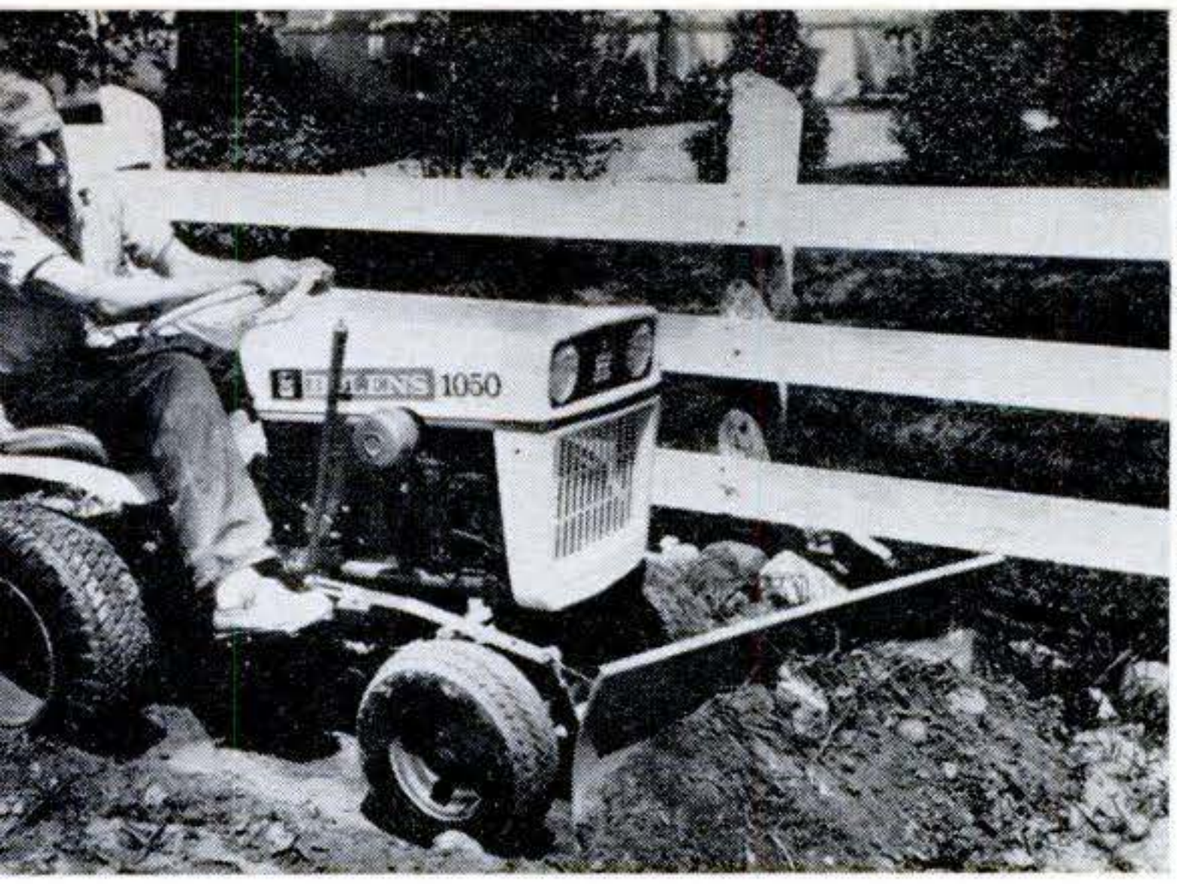

Grading becomes a do-it-yourself job with a Bolens and 42-inch blade. The blade, also handy for snow, works in five positions, has an automatic release.

A snowblower is available for most home tractors. This Wheel Horse has hydrostatic transmission, operated by a speed stick you move forward and back.

Rotary tiller makes seedbed preparation a cinch with a Simplicity Landlord 2010. This tractor offers an optional hydraulic lift for such attachments.

Mowing goes fast with a tractor. This International Harvester 123 Cub Cadet is one of those now fitted with hydrostatic drive—and infinite speed range.

tors are sold with tillage accessories, but when cultivation is among your needs, you must have power.

Ease with which powered attachments hook on is important. Some may take excessive belting or special adapters. Also check out the power takeoff, for powering auxiliary equipment such as generators, saws, compressors. Some tractors have PTO on both sides; some, front and rear. PS

you'll find on the market this year

unique spline hookup for rigs driven by engine; 2,500-watt generator; PTO. Features: toe-and-heel forward-backward hydro control; differential lock provides gradual application of control.

Case. Hp.: 12, 10. Drive: hydro. Accessories: extensive, including trenchers, post-hole diggers, and other equipment often rentable. Features: PTO; easy-start; headlights.

John Deere. Hp.: 10, 8, 6. Drive: variable speed through "variator" sheave in four speed ranges forward for the upper sizes, three for the lower; variable speeds in reverse to about three m.p.h. Accessories: full range. Features: easy-pull starting; hydraulic lift.

Economy. Hp.: 12, four models. Drive: H-shift transmissions, three speeds forward and reverse; Borg-Warner clutch; full differential. Accessories: full line. Features: double drive wheels; ball and roller bearings throughout;

[Continued on page 222]

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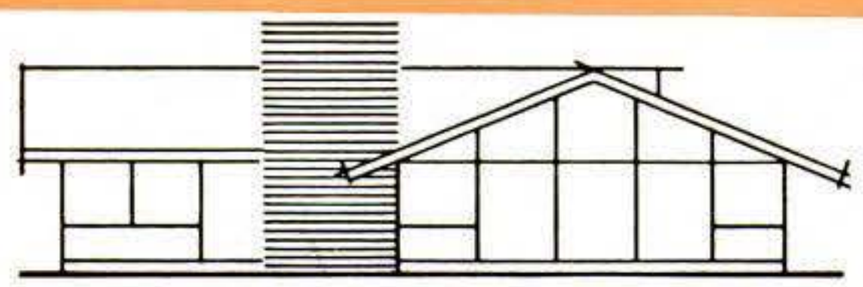
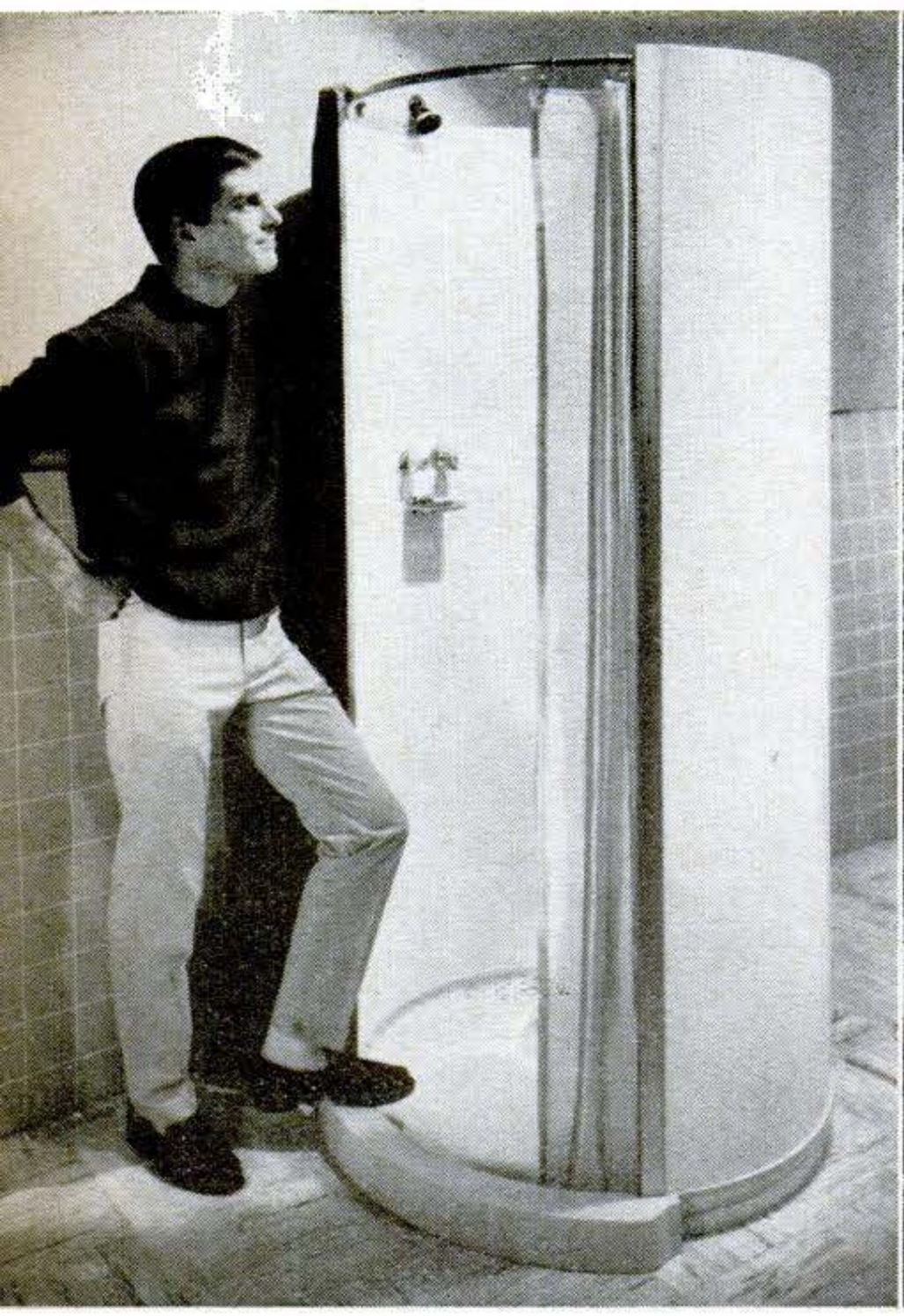
Beginning Here: 40 pages of home-improvement ideas



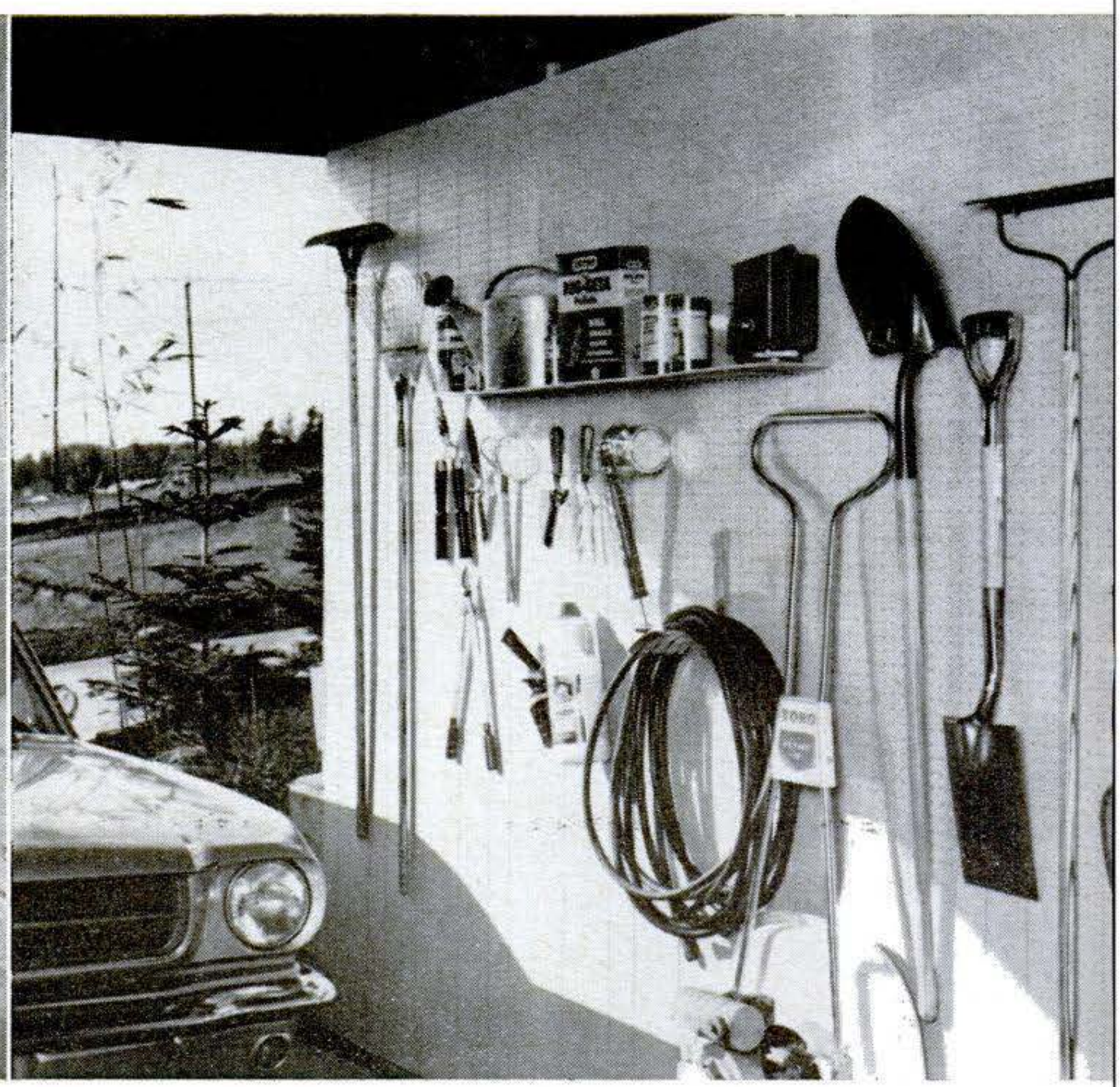
IMPROVE YOUR HOME

Built-in blower is com bined with a bathroo light in NuTone's Vanit Ventlite. The blower a squirrel-cage type fo quiet operation an mounts in standard two by-four walls. The ligh unit and a matching mirror-fronted vanit compartment mount o the finished wall. Th combination comes i five sizes, ranging fro 24 to 48 inches wide, i either standard or de luxe models, to fit a bathroom situations.

New Home Products You



A fiberglass and aluminum shower can be put together in just 15 minutes, according to the Swan Corp., 721 Olive St., St. Louis, Mo. 63101. Hardware and curtain come with the kit. $89.50, pastel blue or yellow.



New hardboard panels offered by several companies have perforations over only two-thirds of their length. The remaining third of the four-by-eight panel is random V-grooved. The panels come prefinished in ivory in thicknesses up to ⅜ inch or in wood grain up to ¼ inch. The thicker board is ideal for heavy garden tools. Indoors, a chair rail along the separation line of perforations and V grooves gives a wall a wainscot effect.

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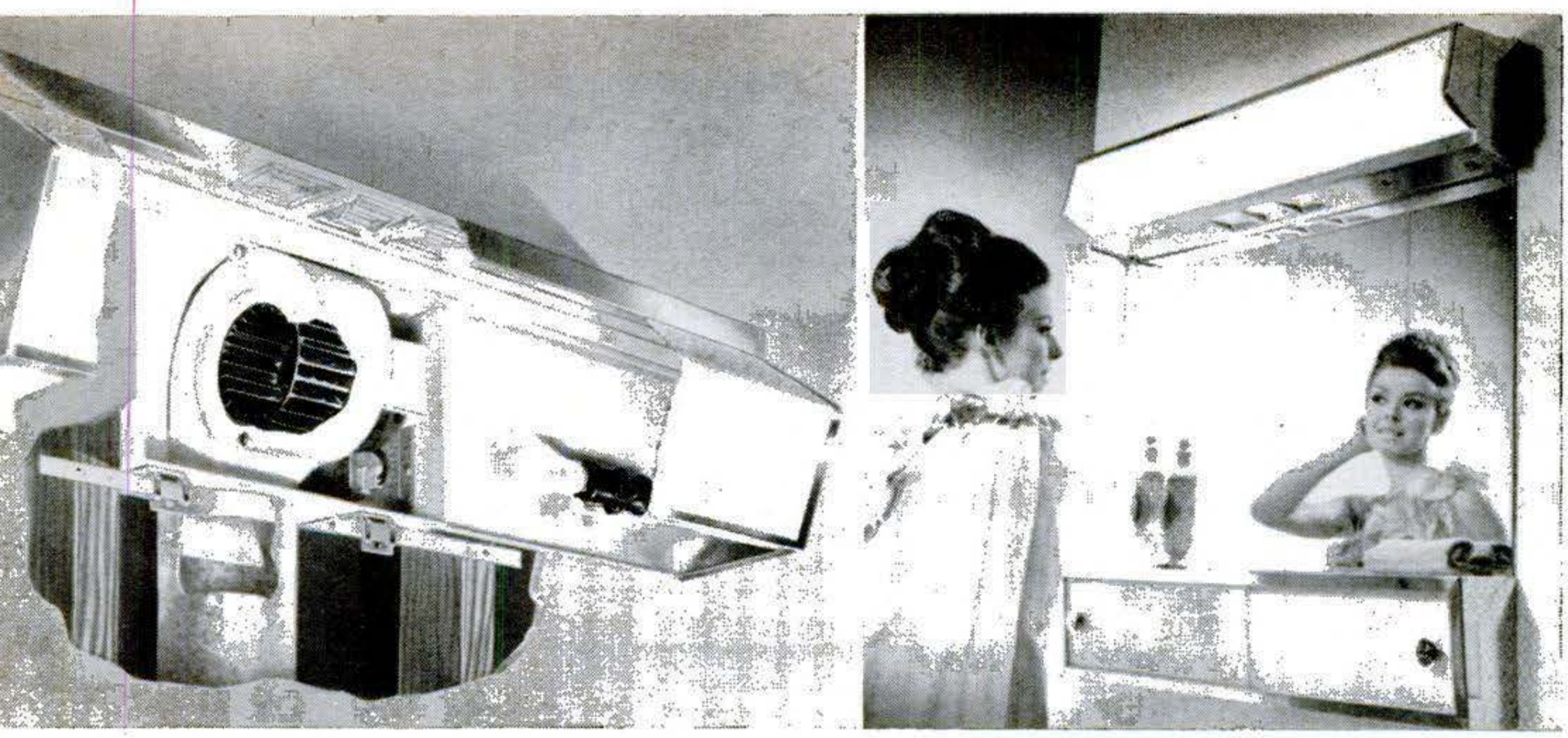

Should Know About

A fourth bathroom fixture is being promoted for American homes. To the conventional tub (or shower), toilet, and lavatory, American-Standard would have you add a bidet, a sanitary facility common for years in Europe. What's a bidet? The word is French, meaning "small horse." Word detectives say it may have derived from the needs of French cavaliers who, in the days when a full bath was difficult to come by, wanted a ready means of bathing those parts of the body in close contact with their saddles. The American-Standard bidet, shown in the photo above adjoining a toilet, has hot and cold controls and a spray rinse. *Continued*

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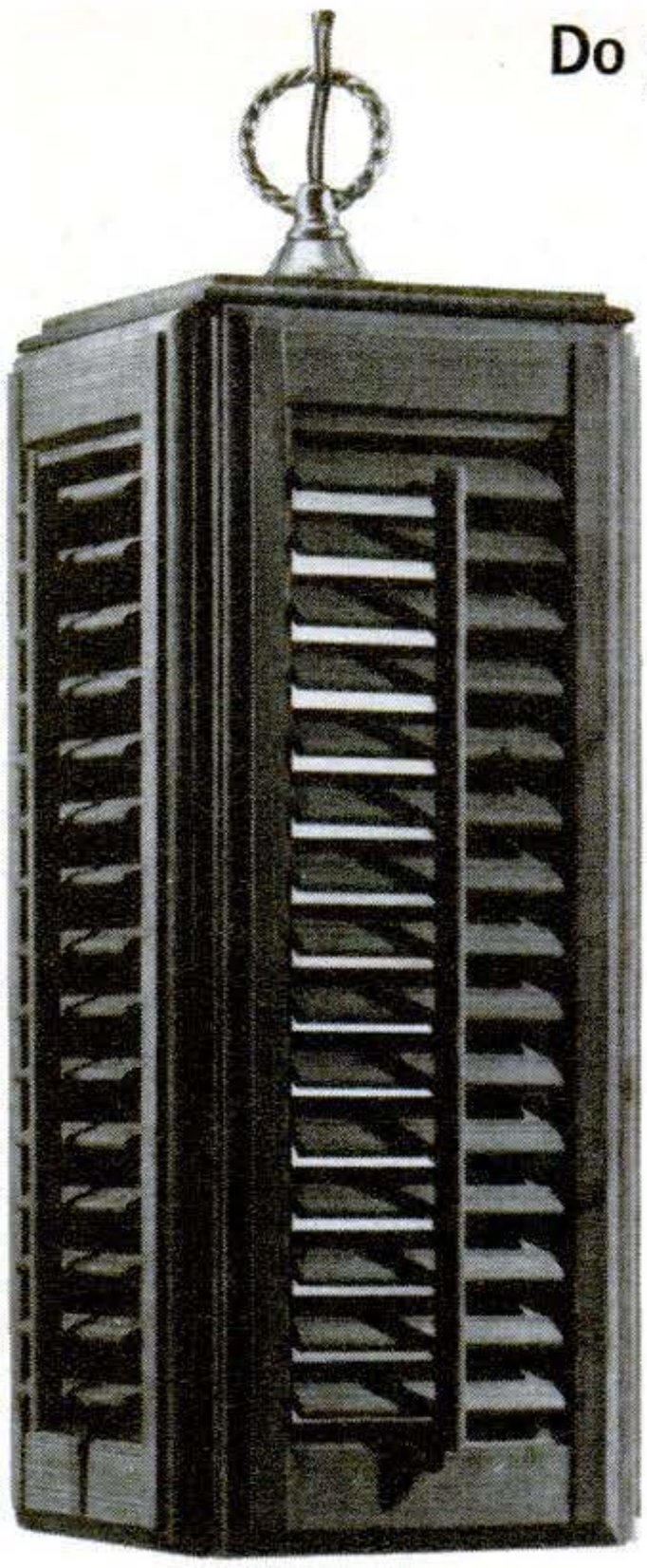
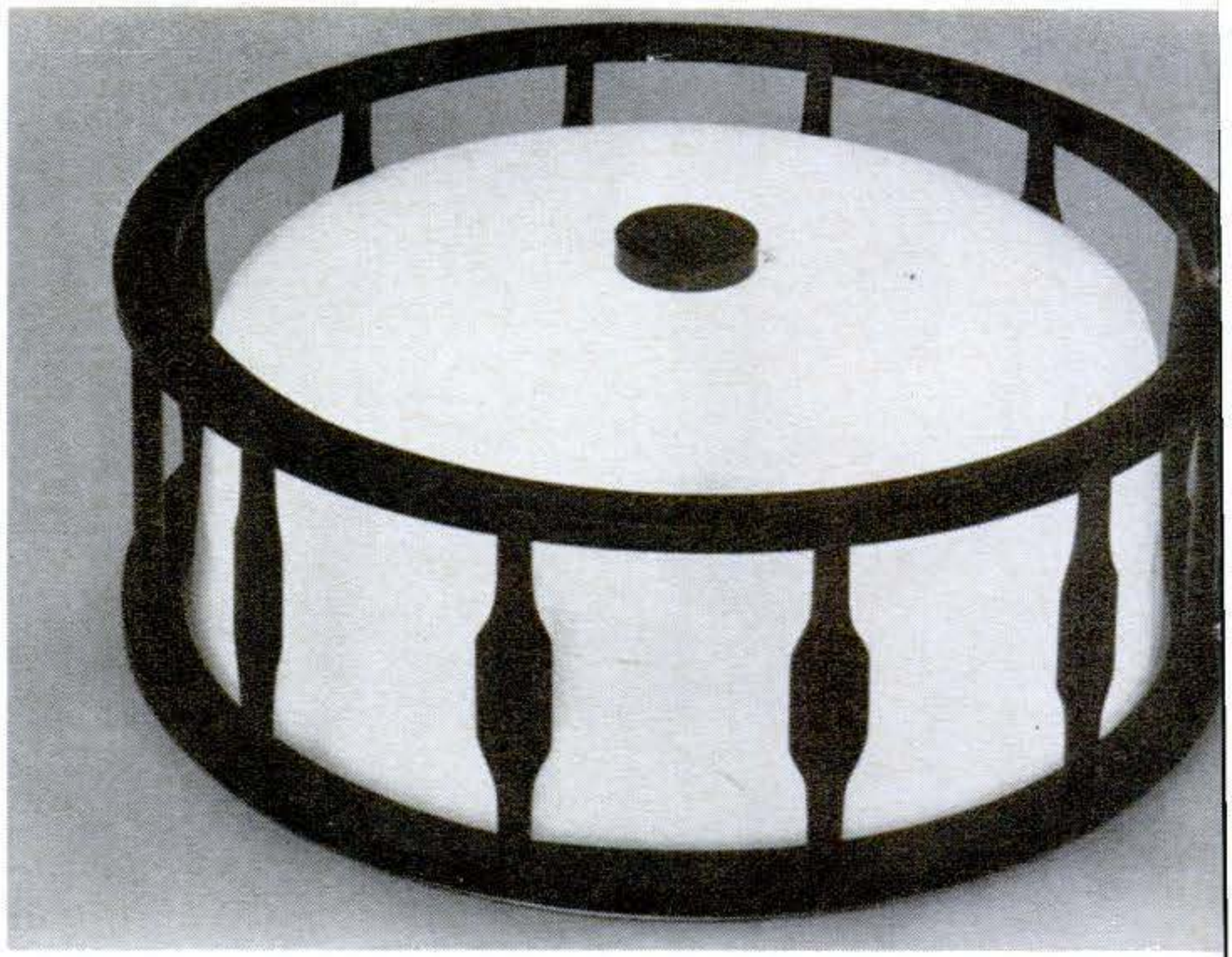
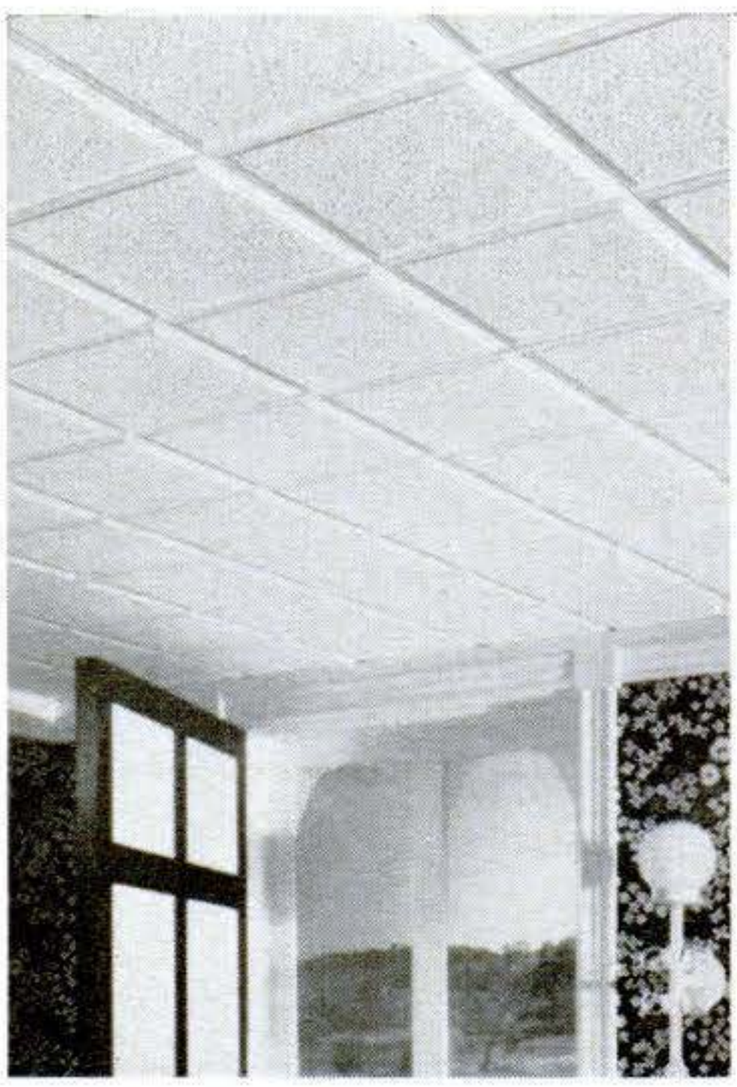
Do you have a home-improvement problem? Some

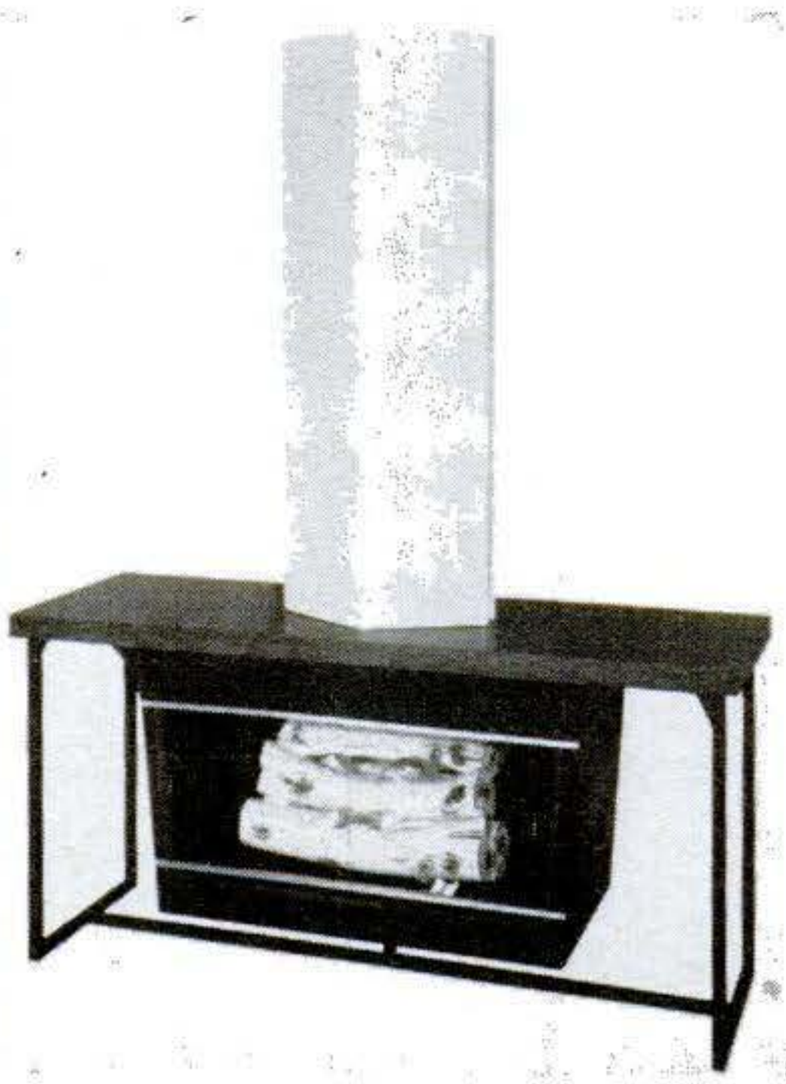




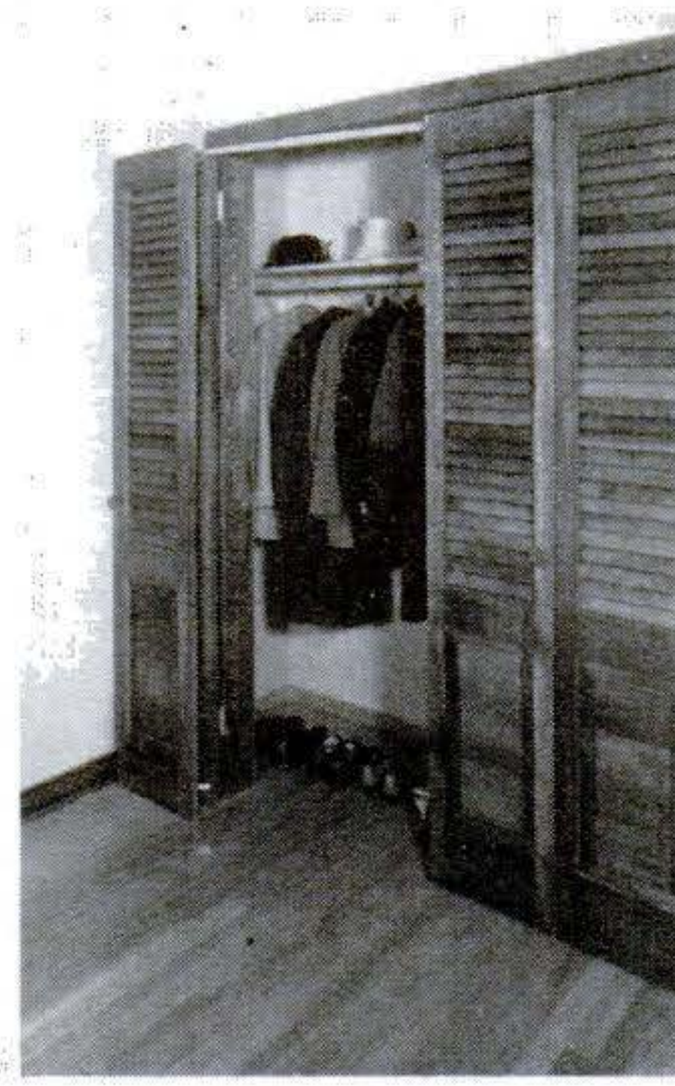
New lighting fixtures offered by Emerson Electric are variations on traditional designs. Two of them are shown here. The Nantucket, on the left, has working shutters adjustable up, out, or down for different lighting effects. Made of California redwood, it has a clear, protective finish so that it can be used outdoors as well as inside. The other, the Copenhagen, derives from an early 18th-century Shaker design. The spindles are natural walnut.



Wide-bevel ceiling tiles that give a ceiling an "inlaid," three-dimensional look are offered by Armstrong Cork. Dover Temlok, one of two styles, is shown in the photo above. The other, Brunswick Temlok, has simulated wood graining. Cost for a 12-by-15-foot room: Dover, about $45; Brunswick, $54.



A fireplace of striking new design can be used free-standing or built into the wall. The fire chamber is suspended from a five-foot walnut wood-grain mantel, and the unit rests on steel legs. Fire-chamber openings come in 36-, 42- or 48-inch widths. Raymond Loewy/Wm. Snaith designed it for Donley.



Telescoping bi-fold hardware by Stanley swings hinged doors 180 degrees. The operation of the aluminum track is not affected if the door warps or becomes misaligned. In closet above, the doors clear opening. Hardware sets ($4.25, $5.25) fit standard openings.

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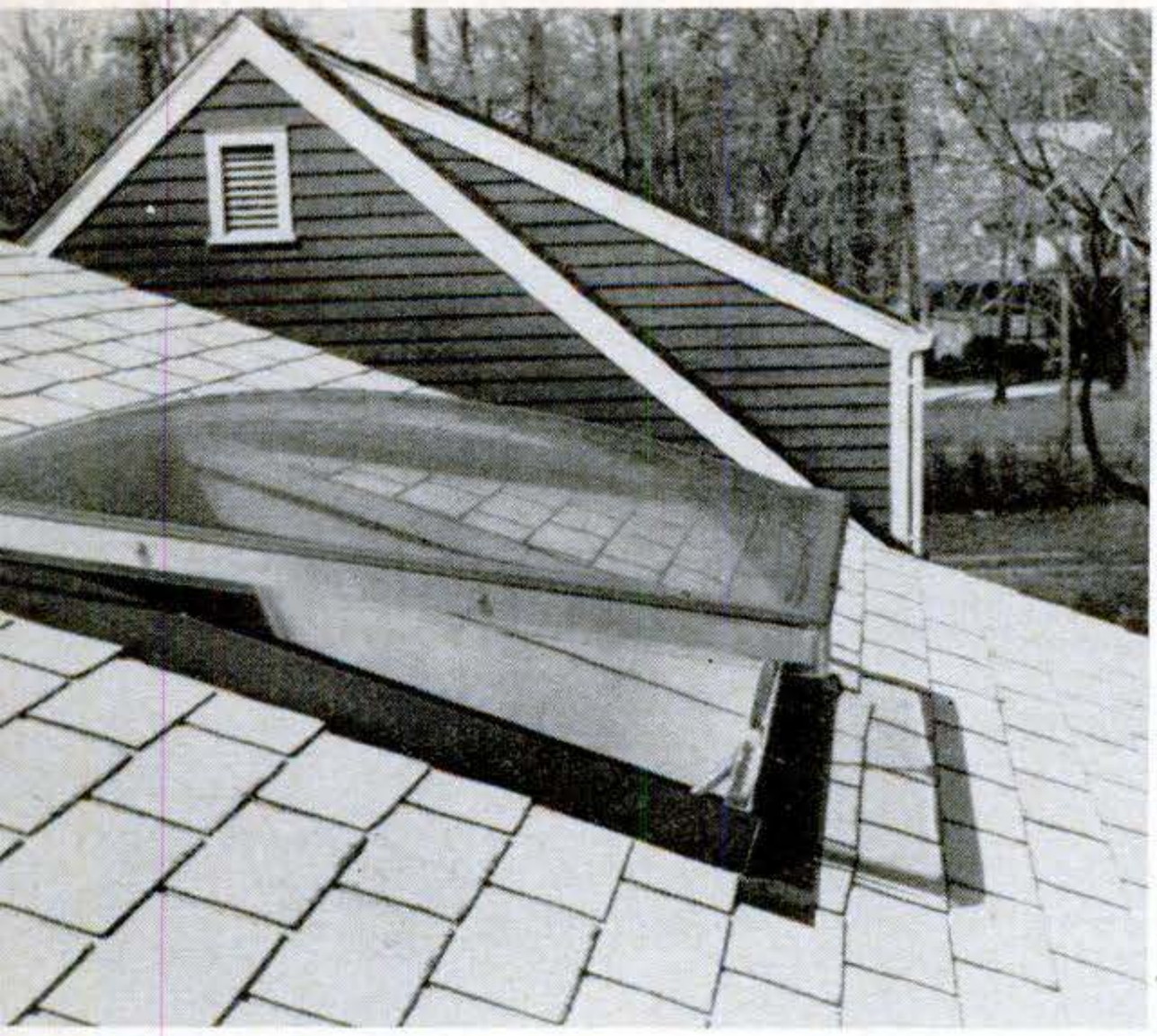
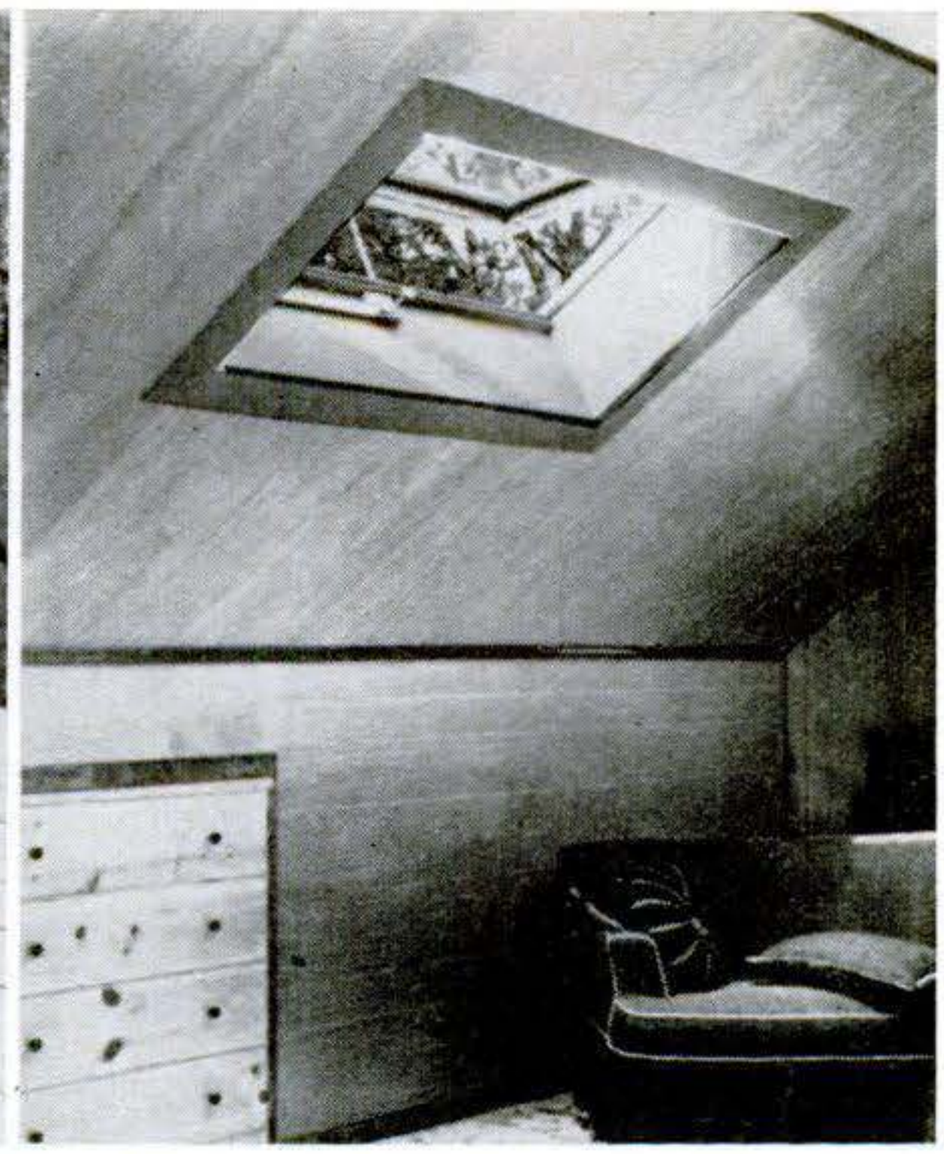
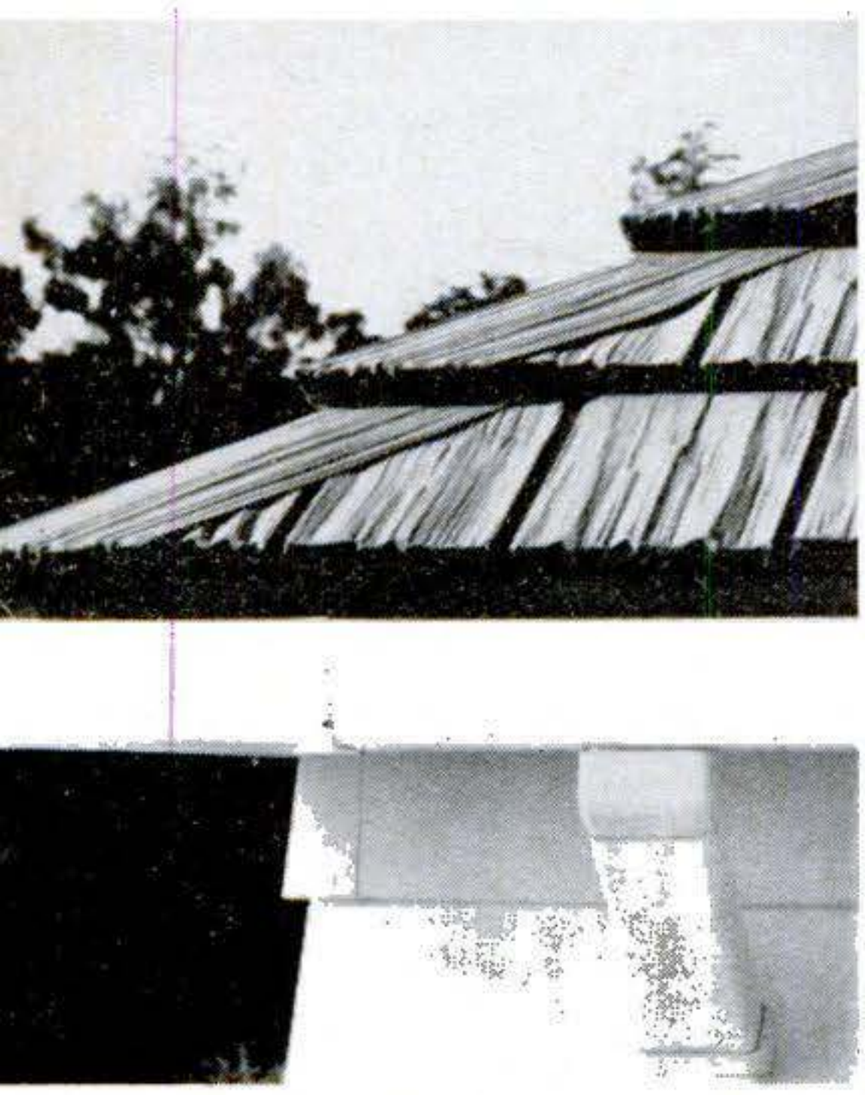
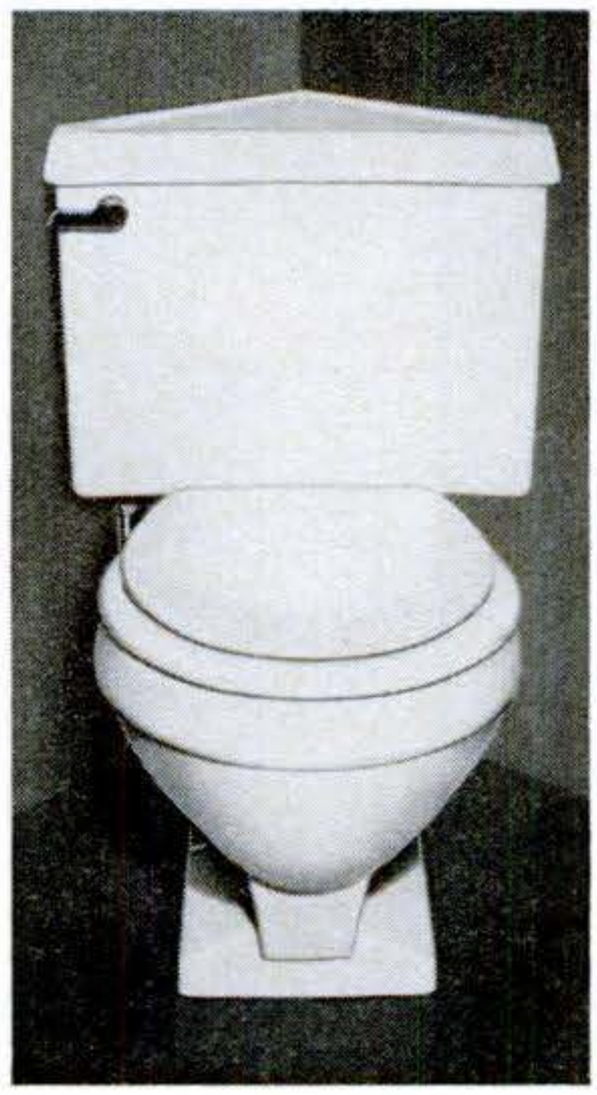
se and other products now on the market may help you solve it

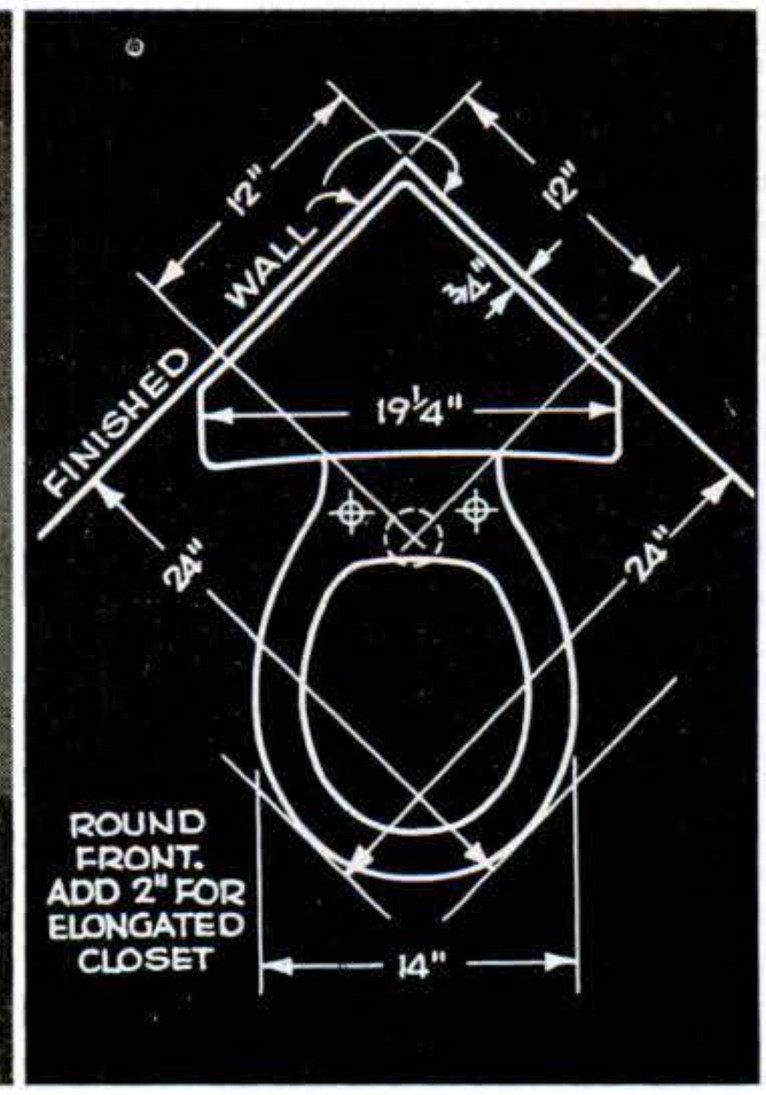




Need more light in an attic? In situations where you might normally use an expensive dormer to bring light and air to an attic, you now can use a dome skylight offered by Ventarama Skylight Corp., Port Washington, N.Y. It can be installed in less than a day on pitched or flat roofs. The double dome of acrylic plastic provides both insulation and light, and can be opened for ventilation—as shown in the exterior and interior views above. The weatherproof base is a high-density, hard-surfaced plywood originally produced by Georgia-Pacific for marine decking and cargo containers. The skylight can be used in a house of almost any architectural style.







Hand-split wood shakes? Actually what you are looking at above is Kaiser Aluminum's new Rustic Shingle roofing. It's offered in three colors—brown, white, and green. Because the roofing weighs only 50 pounds per square, it can be installed over as much as two layers of old asphalt shingles without adding excess weight. Some builders and remodelers also are using the same aluminum shingles, which don't rust or crack, as a new premium siding.

A triangular toilet tank, the Triangle, has been introduced by Eljer. Installed, the siphon-jet closet combination occupies a corner floor space only two feet square—as shown in the drawing. This suggests more flexibility in planning—the possibility of a full bath or half bath (toilet and lavatory) in an area much smaller than ever before possible. Doors can open with more clearance. The closet is available in white and a choice of six colors. PS

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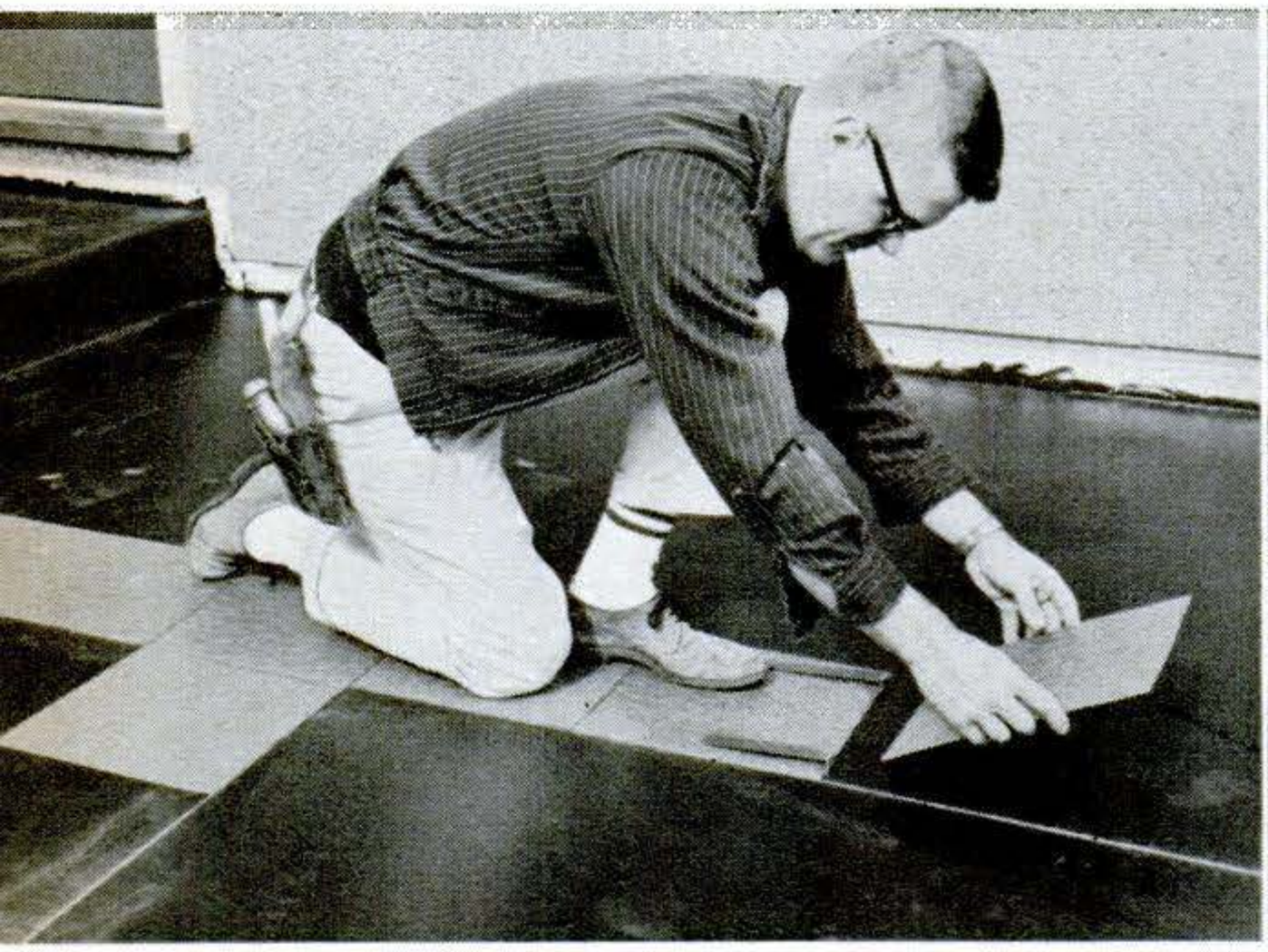
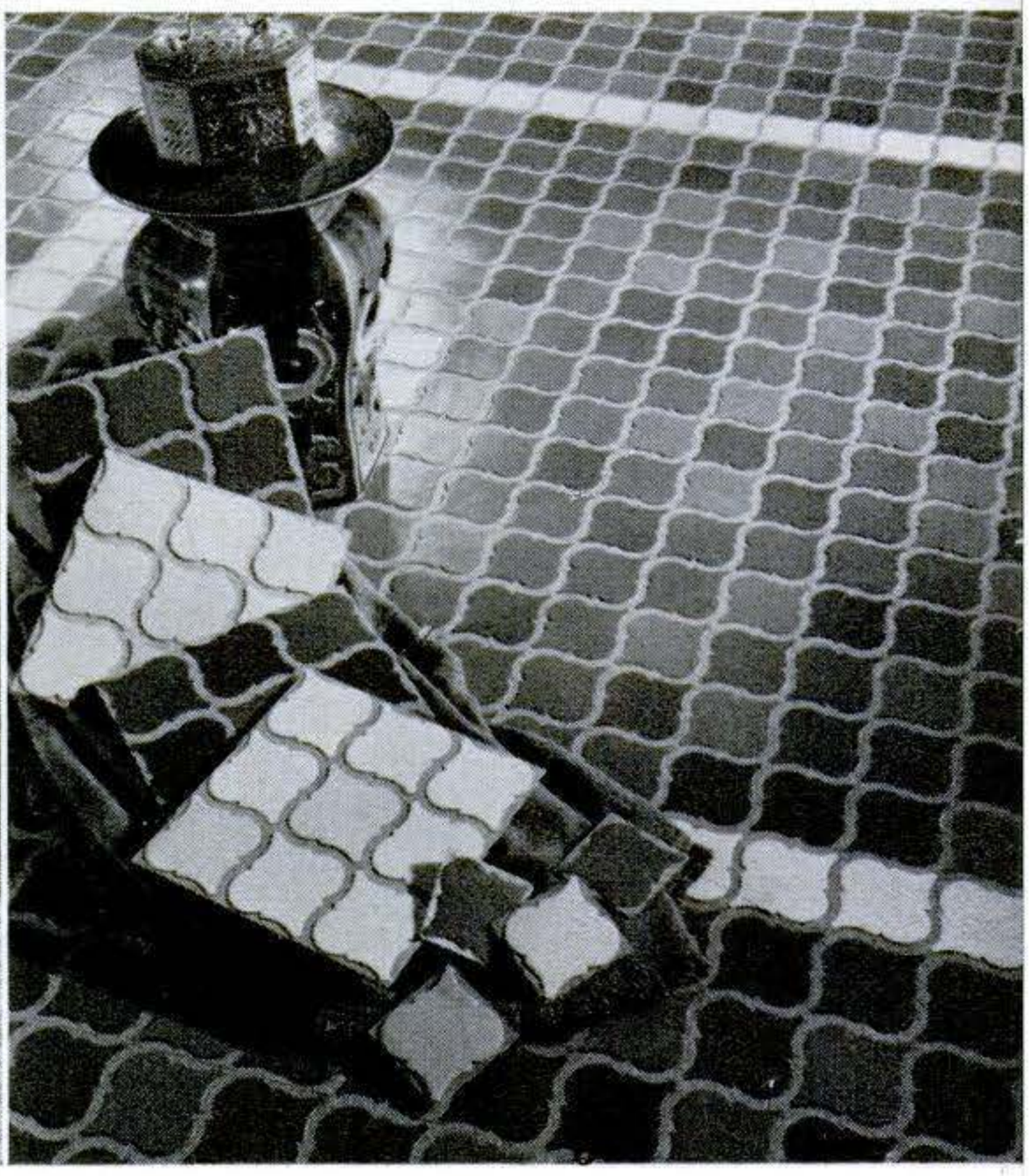
New Patterns i



Extreme resistance to weather and wear, and easy maintenance, are claimed for this heavy-duty, outdoor resilient floor tile by its maker, Armstrong Cork. A neoprene primer goes onto the concrete, then a contact cement, then the Weatheron tile. The use of metal spacers while laying the tile gives a 1/16-inch open joint for expansion and contraction. The tiles are 12 by 12 inches, and have an embossed surface texture. You can choose from four colors.



Swirling mosaic patterns minimize joints and help conceal heel and scuff marks in this embossed vinyl-asbestos Palatino tile. You can put down the 12-inch squares over wood or concrete floors. The maker, Azrock Floor Products, says it resists grease and other stains.

Mediterranean styling is apparent in Kentile's Moda Moresca, a new solid-vinyl tile. The patterned tiles-within-tiles in each 12-by-12-inch square are made in different shades to give the random effect of hand-made ceramic tile. Basic colors are: white, beige, red, brown, and gold.

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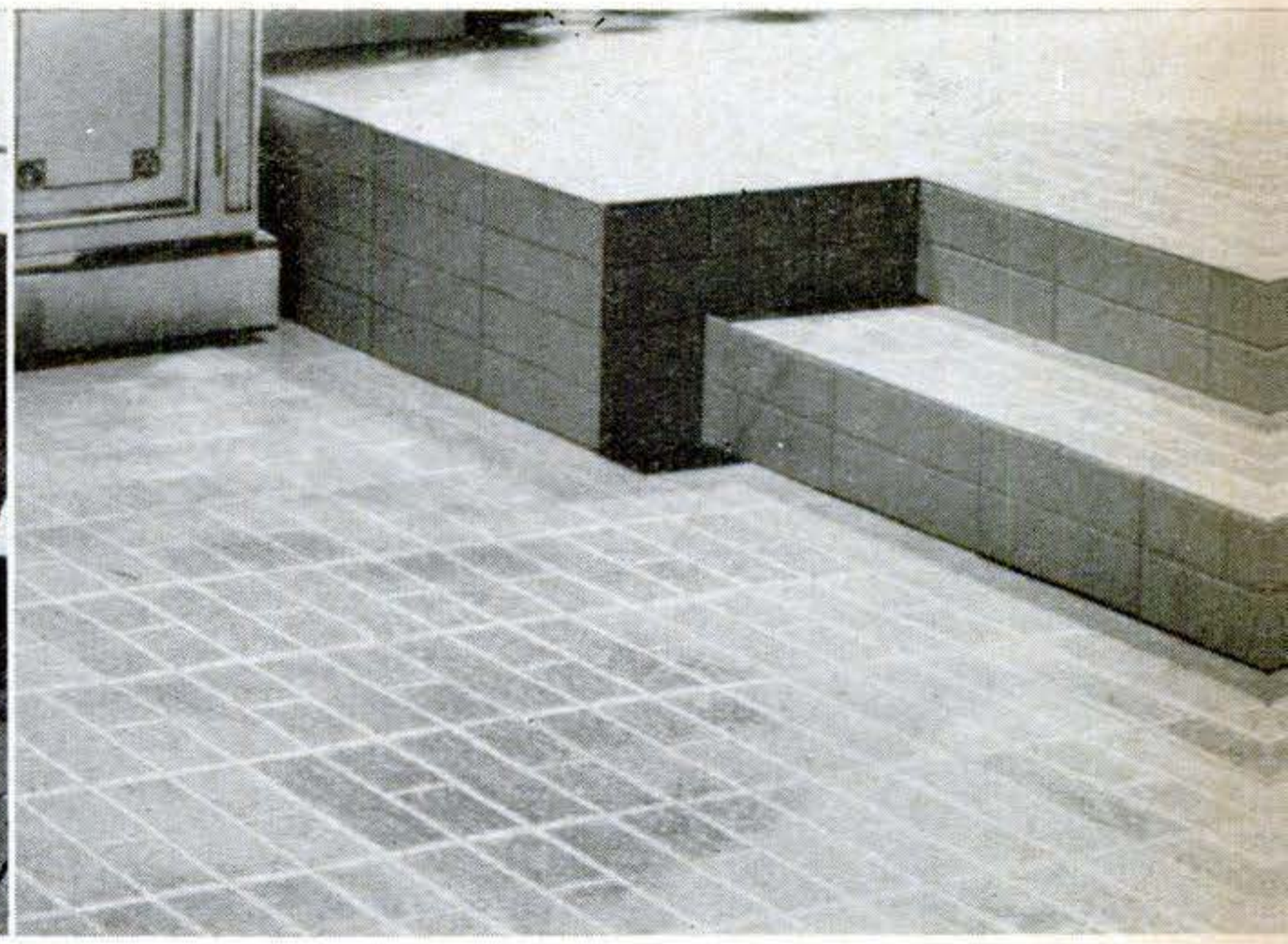
loor Coverings



TThe look of hand-laid flooring is captured in these two embossed tile patterns. Both have grout lines around each brick to conceal the seams. They come in red or white with a complementary shade of grouting. Each style can be laid in a variety of designs. Armstrong's (left) is nine-by-nine-inch solid vinyl with three weathered-looking bricks to the tile; Johns-Manville's (right) is 12-by-12 vinyl-asbestos suitable for above-, on-, or below-grade application.

I If you like real quarry tile but the budget says no, you'll go for the new tile shown above. The realistic mortar design around the edges masks the cracks between the 12-inch-square tiles to create an unbroken wall-to-wall effect. Johns-Manville makes them in blue-gray, red, ivory.

Here's a multicolored floor enamel that you could almost mistake for wall-to-wall carpeting. It's designed to be sprayed on indoor concrete floors and is said to cost only 10 cents a square foot professionally applied. Called Multakolor, because separate droplets retain their individual colors, the paint gives a finished look to basement rooms and provides a highly abrasive- and skid-resistant surface. The Marbon Chemical Division of Borg-Warner makes it.

New Windows and Doors

The touch of a finger moves windows and doors riding magnetic tracks

By WALTER E. BURTON

A 170-pound sliding door that normally requires an eight-pound shove glides to one side with a 12-ounce tap. The touch of a feather sets a sliding window in motion. And all this in absolute silence.

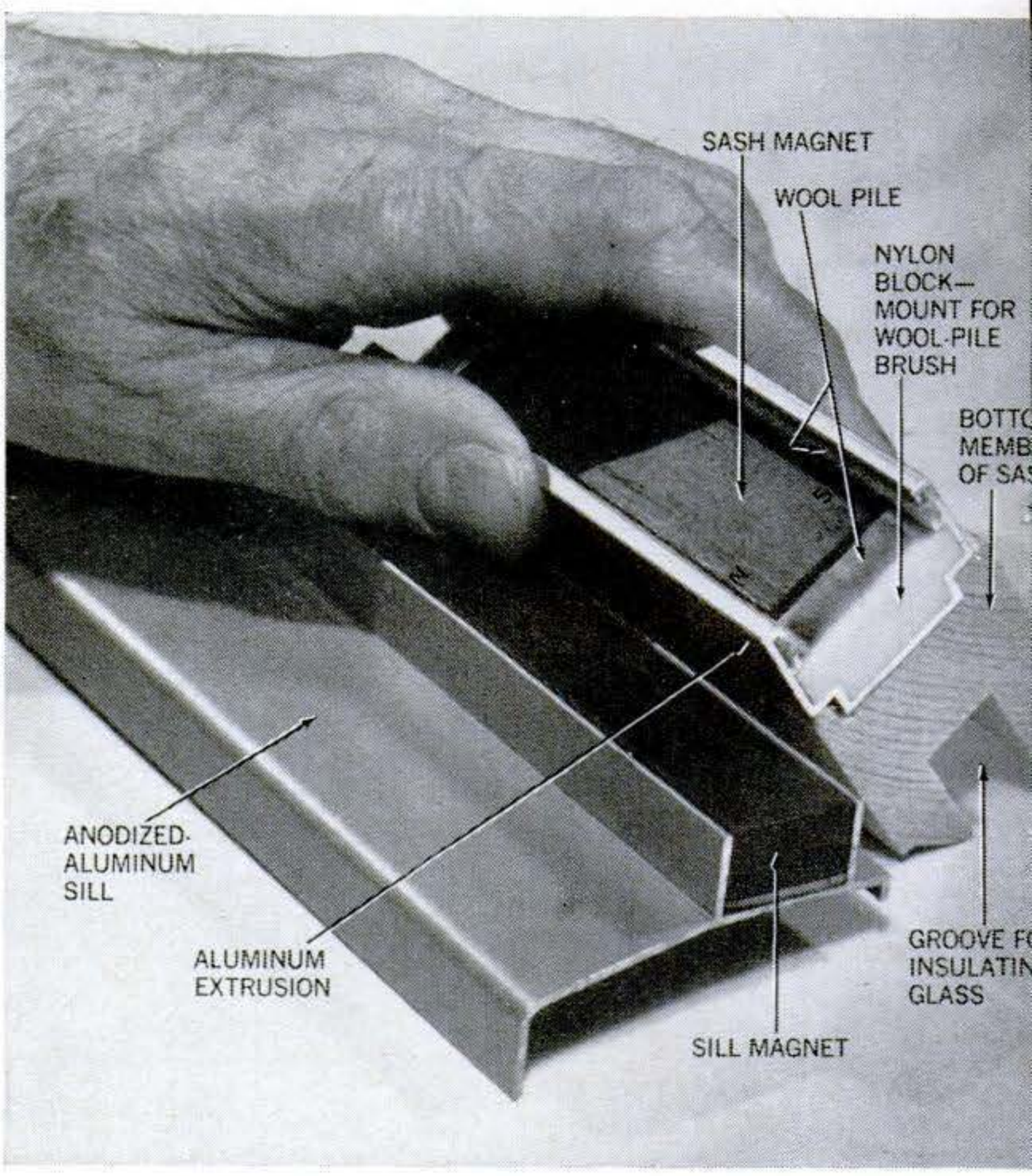
The secret is in flexible magnetic stripping that keeps a gap of a few thousandths of an inch between the window or door bottom and its channel. The Kushion-Aire windows and doors literally glide on a layer of air.

The magnetic strips consist essentially of magnetized barium ferrite in a rubber or plastic matrix. One strip is mounted along the lower edge of the sash; below it on the window sill is another strip. The like poles of these strips are positioned directly opposite each other so each magnet tries to push the other magnet away. Heavy sliding doors use three pairs of magnetic strips. The strips are said to retain their full magnetic strength indefinitely.

Wool-pile weatherstripping at the top and bottom of the sash prevents drafts, and wool-pile brushes at the ends of the sash magnets sweep dirt from the track.

Ready-glazed wood and aluminum windows with these new features are already being made by Weather-Seal, Inc., 324 Wooster Rd. N., Barberton, Ohio 44203. Insulating and regular glass windows are available. It is expected that double-glazed patio doors using the same principle will go into production in a few weeks.

Window sashes snap in and out for handy cleaning. Just lift sash up, and it swings off the track at the bottom.



Heart of the mechanism is shown in this full-scale model. The magnetic strip is set in an anodized extruded-aluminum sill. The sash has a similar strip with a nylon block faced with a wool-pile brush to keep the sill magnet free of dirt.

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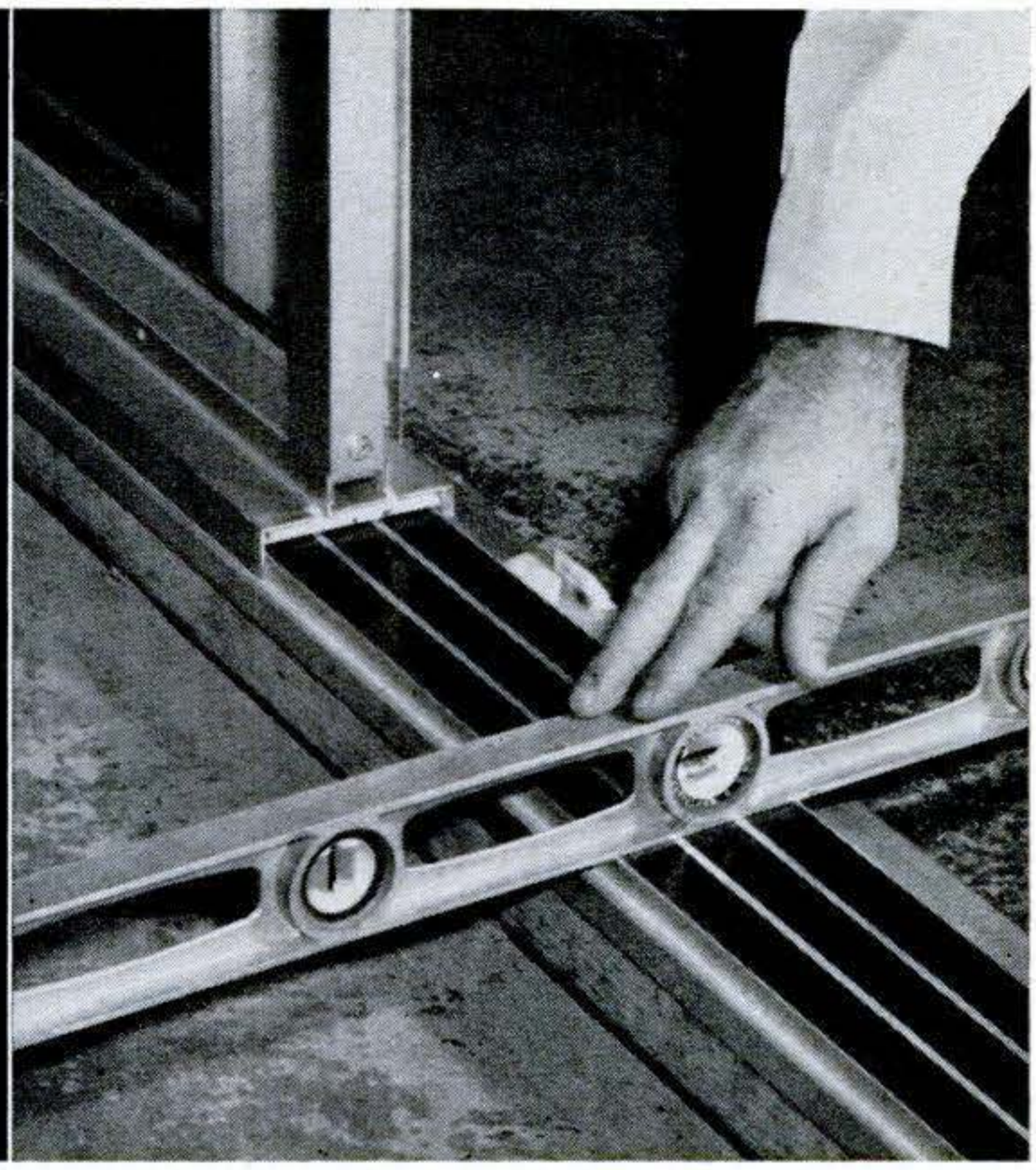
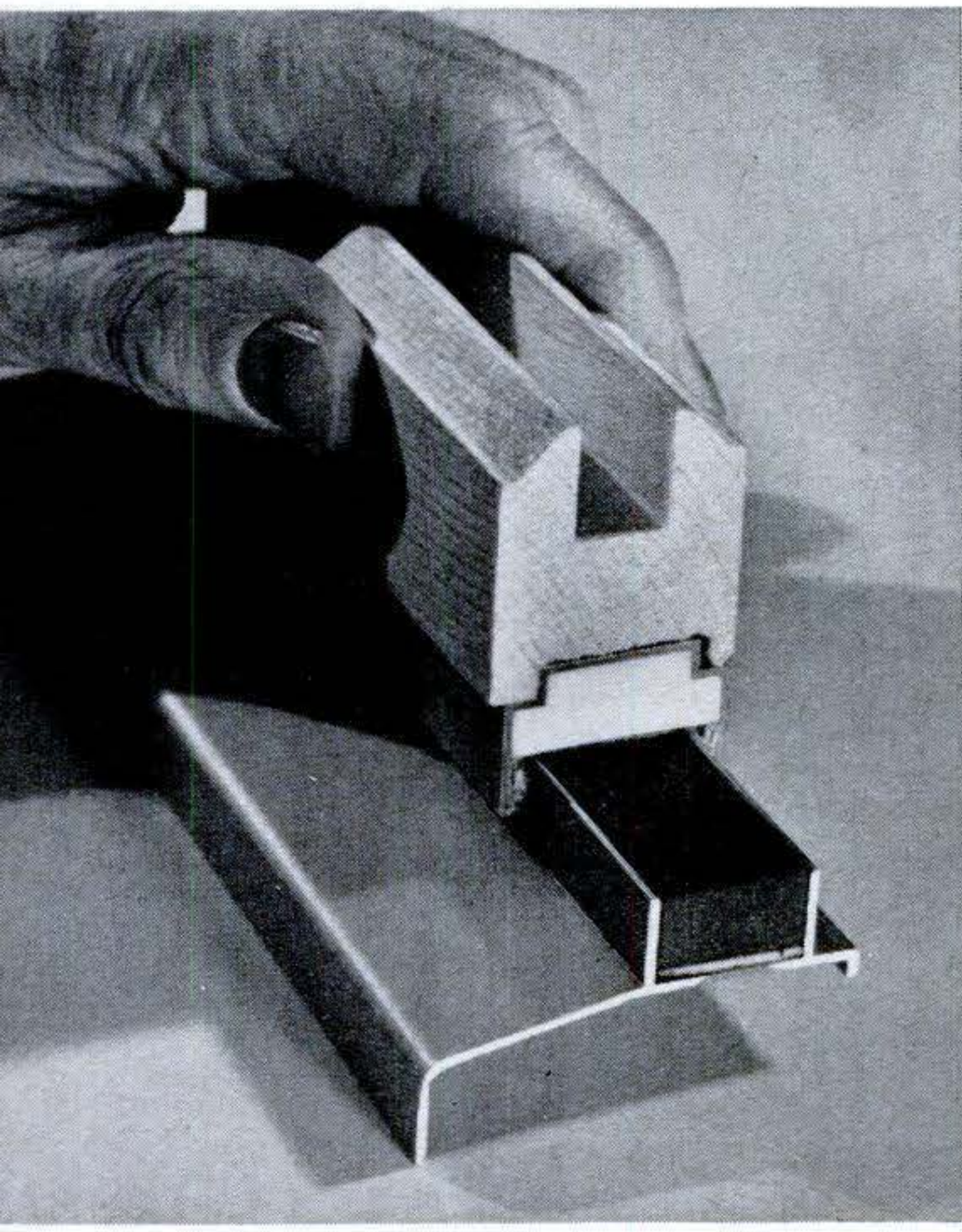
Slide on Air

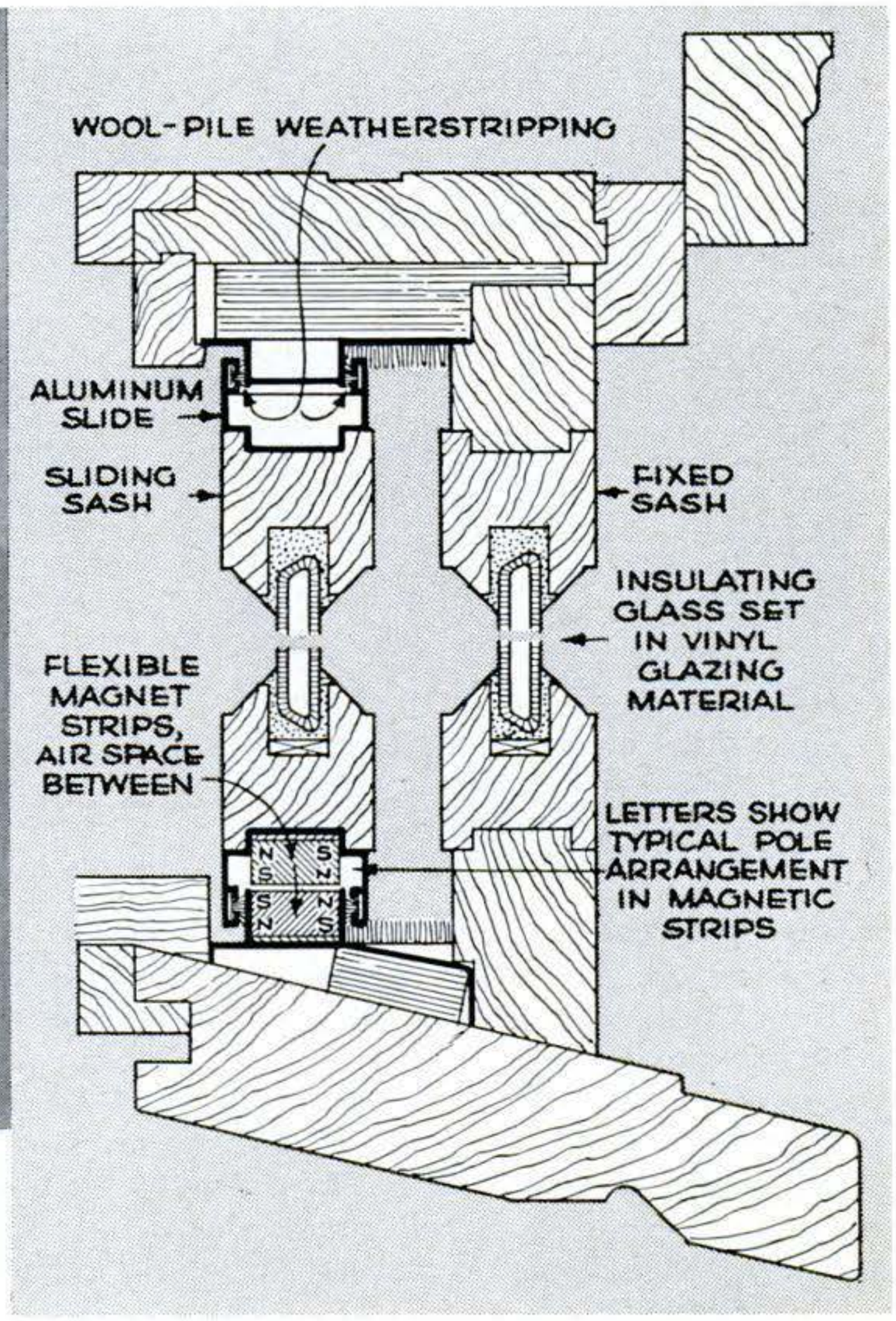
Touch of a fingertip opens and closes windows. Doors require only a fraction of the normal effort.



Track for patio doors has three magnetic strips, and is flush to prevent spike heels from catching.



Sash section of the model is shown in normal operating position, with the magnets in mutually repelling alignment. Wool-pile stripping extending on both sides acts as a weather seal.



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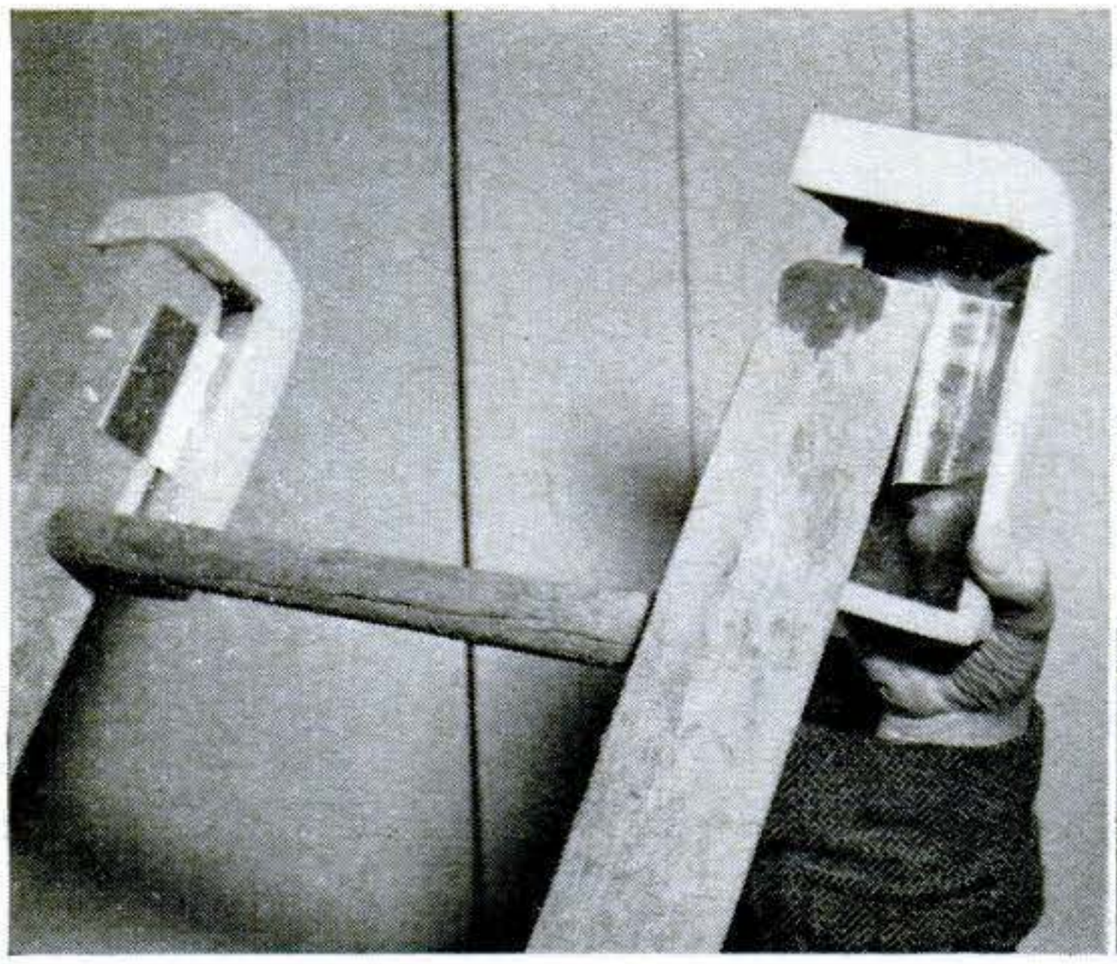
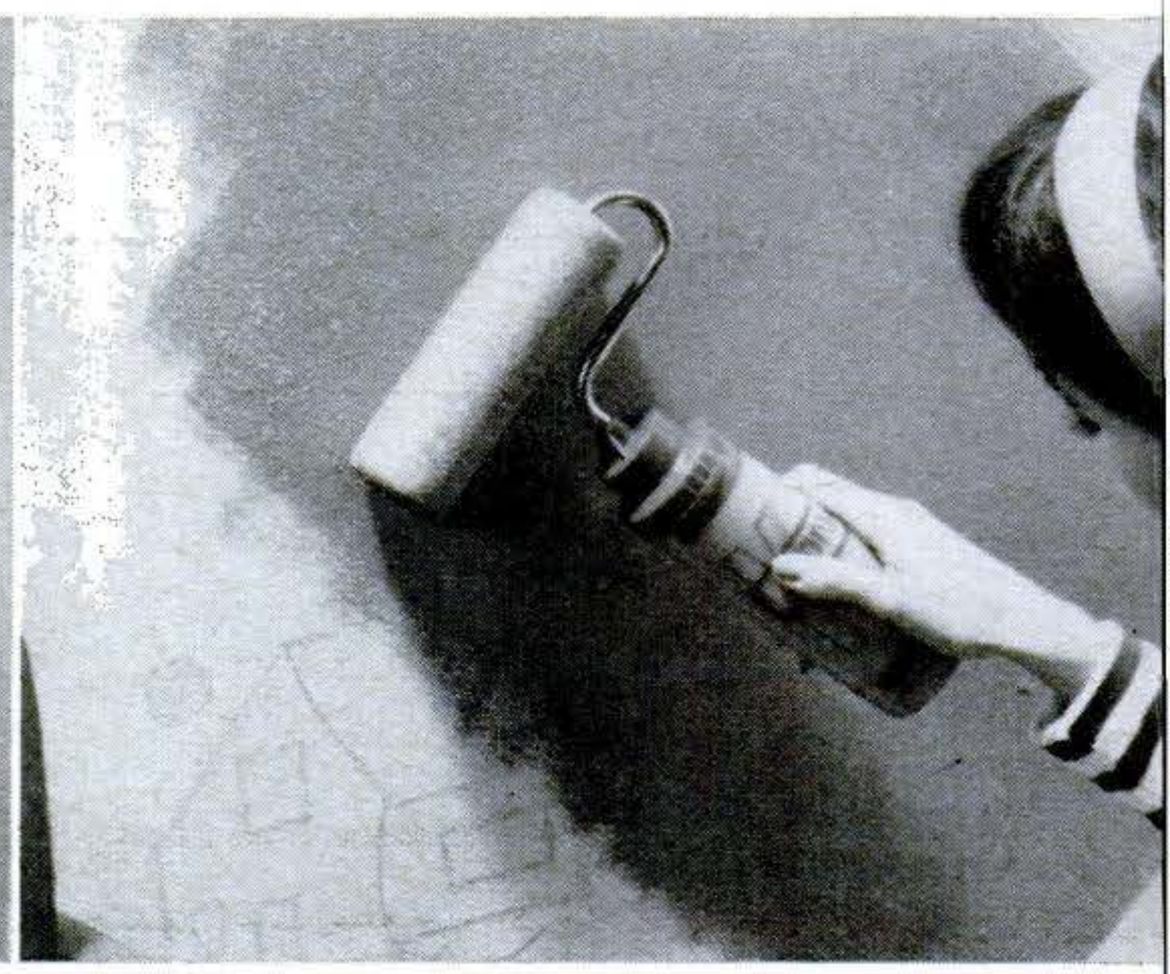
IMPROVE YOUR HOME

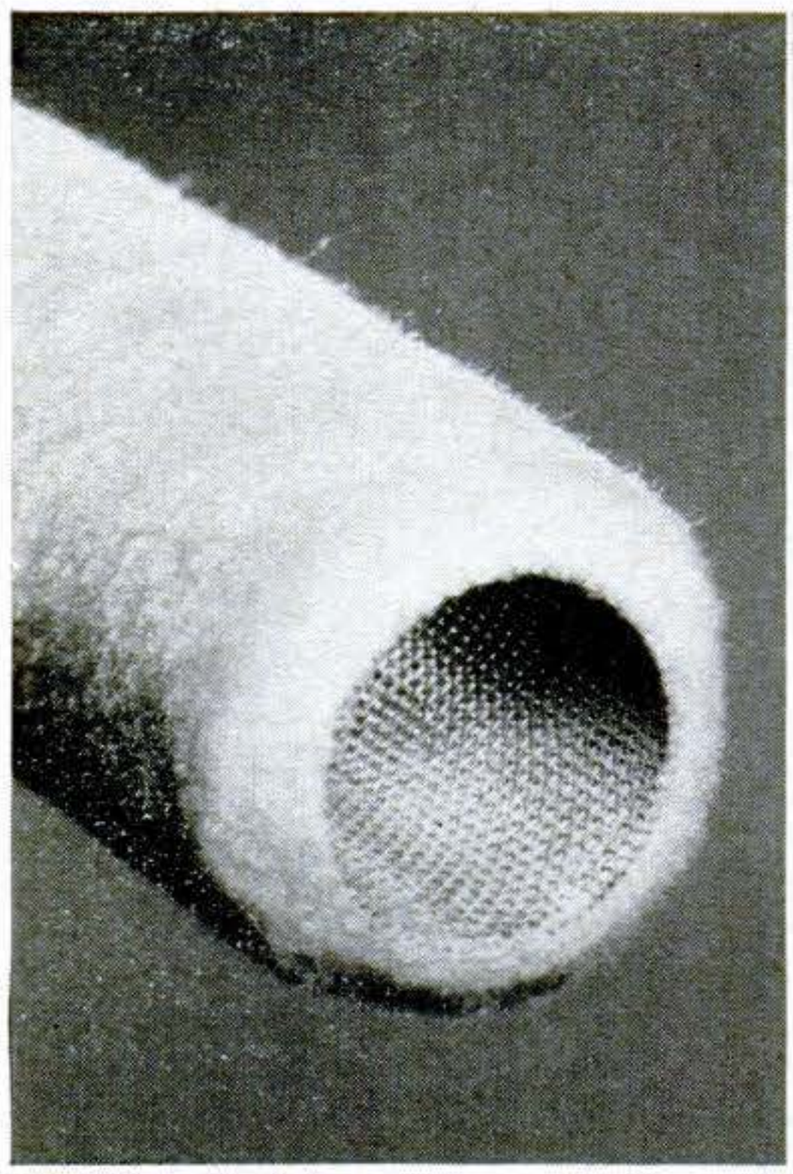
Products for Painters



Ladders won't mar paint with these scuff guards on the top ends. The foam-plastic covering also prevents breaking siding and makes the ladder less slip-prone. Spring clips hold on the guards. Dan-D Paint Products, 60 N. Washington St., Rochester, N.Y. 14614, makes them. $1.98 a pair.



The paint's in the handle of this roller, called the Koto-Matic. The handle—a polyethylene container—holds enough paint to cover 70 square feet. It comes with a protective cover for the roller and a plastic pouring spout. National Silver Co., 241 Fifth Ave., NYC 10010, sells it.



This roller comes clean all the way through; it has a plated wire-cloth core that lets cleaning solvents pass through the cover material. It's made to fit 1½" roller frames, and comes only with seamless Dynel covers. It's made in 7" and 9" widths, with ⅜" pile, by Thomas Industries, Louisville, Ky.

A "hole in the head" can be useful—in a paintbrush. A multi-step hook provided with this brush lets you suspend it at the proper level in a can of solvent between jobs. A hollow brass rivet in the hole helps to hold on the ferrule. The Edy Brush Co., 1 S. West St., Mt. Vernon, N.Y., is the maker.

New hand-held dispenser help you put masking tape righ where you want it, and give you square-cut tape ends. The Zip-N-Clip ends a lot of the headaches of using masking tape; it holds tape ends unstuck ready for use, and eliminates guesswork cutting. Unipat, 135 S. LaSalle St., Chicago, sells it

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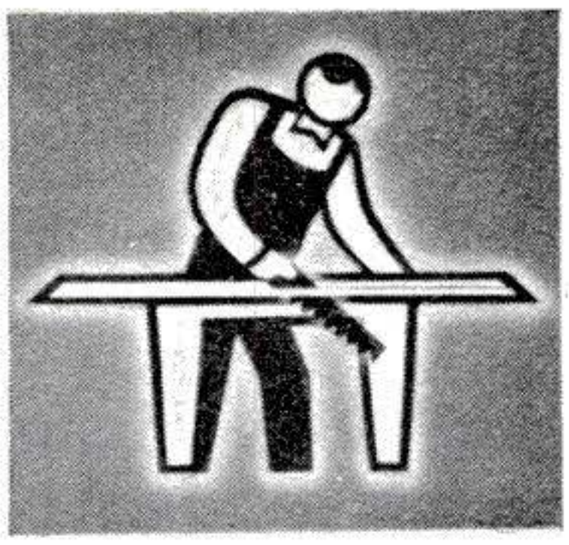

Shop Talk

By ROBERT P. STEVENSON

Home-improvement tips that you can get for the cost of a stamp

What's your problem? Whatever it is, there's probably a company somewhere with literature designed to help you solve it. Among good offerings I've seen lately are the following, all free:

If you're planning to panel a room, and intend to choose from the many hardboard panels available, write to Masonite, Box B, Chicago 60690, for instructions on installing the company's Royalcote line. The folder also shows how to put up Marbletone ceiling panels. And while you're writing, you might also ask for Masonite's instructions on installing Filigree panels and an eight-page booklet "How to Be Your Own Decorator." Besides showing appropriate color combinations, the latter tells you how to measure a room for paneling . . . A full-color brochure available from Weyerhaeuser Co., Box B-3625, Tacoma, Wash. 98401, gives you a look at some of that company's prefinished hardboard patterns. Ask for "6 New Muralwood Paneling Patterns" . . . You can use shellac for more things than you can shake a stick at. Ask William Zinsser & Co., 516 W. 59 St., NYC 10019, for "Bulls Eye Spray Shellac Folder" . . . Are there enough casters in use in your home? For word about this, write to The Bassick Co., 960 Atlantic St., Bridgeport, Conn. 06602, for the booklet, "For the Man Who Wants to Be a Hero to His Wife." How's that for a title? . . . Deft offers a series of wood stains that dry fast. For booklet 1020, send a self-addressed and stamped envelope to Deft, Inc., P.O. Box 3216, Torrance, Calif. 90510 . . . For some wood-siding ideas, request a six-page booklet from Western Red Cedar Lumber Assn., Dept. 651-L, 700 Yeon Bldg., Portland, Ore. 97204.

Want to build a bar, a garage? Install outdoor lights? Here's help

How would you like to build a highboy beverage-storage cabinet with a detachable base that you can use as a mobile bar? A 43-page booklet "How to Build a Colonial Tavern Bar Cabinet" is available from Easi-Bild, Briarcliff Manor, N.Y. The bar is designed for the Tapper beer dispenser marketed by Reynolds Metals Co. . . A 20-page booklet on "How to Plan Your Garage" can be obtained by sending 35 cents to Crawford Door Co., 4270 High St., Ecorse, Mich. 48229 . . . For 50 cents, Westinghouse Electric will send you a beautifully illustrated booklet on adding outdoor lighting to your grounds. Send the 50 cents to Add Charm, Box 7040, Roseville Station, Newark, N.J. 07017.

How to restore the natural beauty of marble

The Marble Institute of America has developed a home-use kit for the purpose. Any acid material leaves unsightly marks on the finish of marble but doesn't damage the marble itself. Buffing powder that comes with the kit can be used to remove the marks. For one of the kits, send $5 to the Marble Institute, Pennsylvania Bldg., Washington, D.C. 20004.

New products that you may want to check out

Heavy-duty folding shelf brackets introduced by Stanley are ideal for wall-hung tables or shelves . . . U.S. Plywood is now marketing a product called Scratch Hider—in four shades. It's a paste that makes scratches, gouges, even cigarette burns blend to match the adjoining wood.

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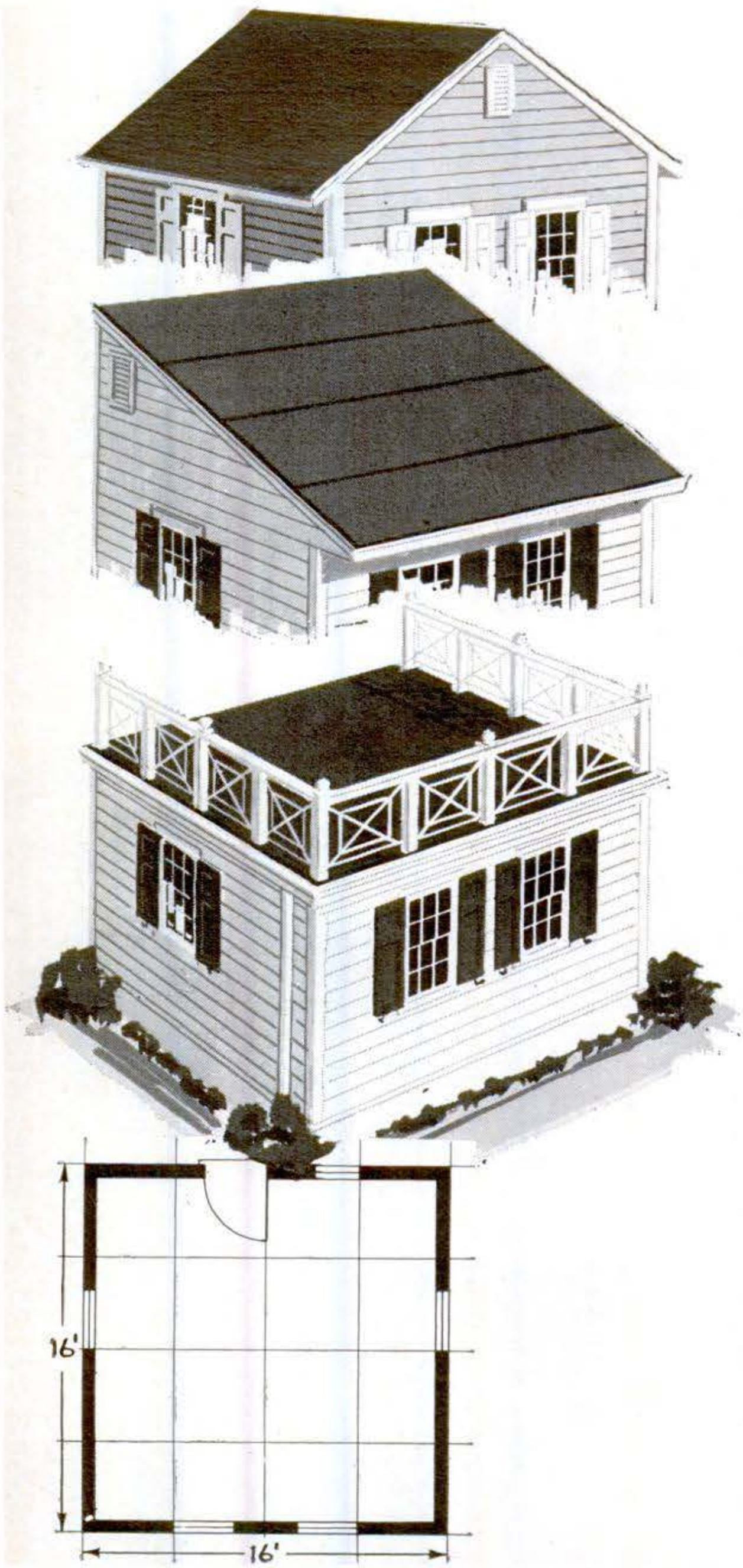
Vary the roof—shed, flat, or gable—and these four-foot modular additions will fit any style of architecture

Two Basic Rooms You



By CARL T. SIGMAN

DRAWINGS BY SIGMAN-WARD INC.

Within 10 years the average family outgrows the two- or three-bedroom house optimistically purchased to last until the children are grown and gone away. The choice, then, is between buying a larger house at a considerably greater cost per square foot or enlarging the house you have.

Here are two modular rooms—one square, one oblong. Either can be attached to the back, side, or front of most styles of houses. The modular units are four-foot-square areas that permit construction without waste. That's because standard-size materials fit the modules evenly. For instance, plywood and composition board come in 4′-by-8′ sheets; concrete blocks lay up to 8″-by-8″-by-16″ dimensions and fit in the module without cutting.

The drawings and blueprints here show how you can add one of these two rooms to your house, doing the work yourself if you wish. But, as noted on the blueprint, you can get a larger blueprint and bill of materials drawn up by an architect. With it you can ask for contractors' bids and file for a building permit.

The footings must be poured on undisturbed earth and below the frost line—the depth to which the ground freezes in winter. Since this varies considerably north to south, check building authorities regarding the proper depth.

It's a good idea to put ½″ reinforcing rods in the footings. If you're using poured-concrete foundation walls, place greased two-by-fours in the middle of the top of

Your New Room Can Be SQUARE

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Can Add to Any House

footings. The groove left when a two-by-four is removed keys the poured wall in place.

Easiest and cheapest, particularly for a do-it-yourself job, is to use cement blocks for the foundation walls. Lay them in mortar on top of the footings, making them high enough to put the new floor even with the house floor.

If your land drops off steeply from the house, the cheapest way to put a foundation under a new room may be to mount it on pillars, with an open area beneath. This brings it up to the level of the house. The pillars may be either poured concrete or cement blocks.

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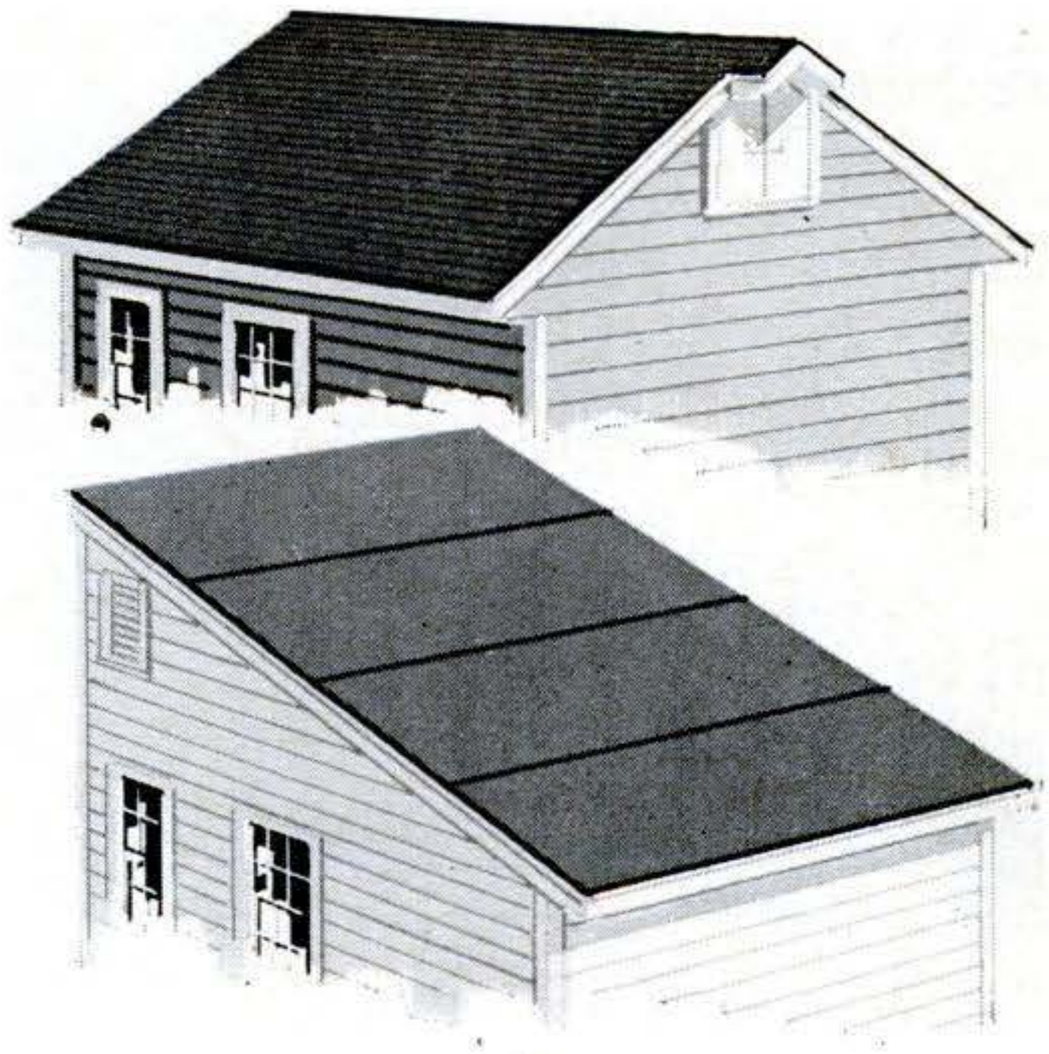

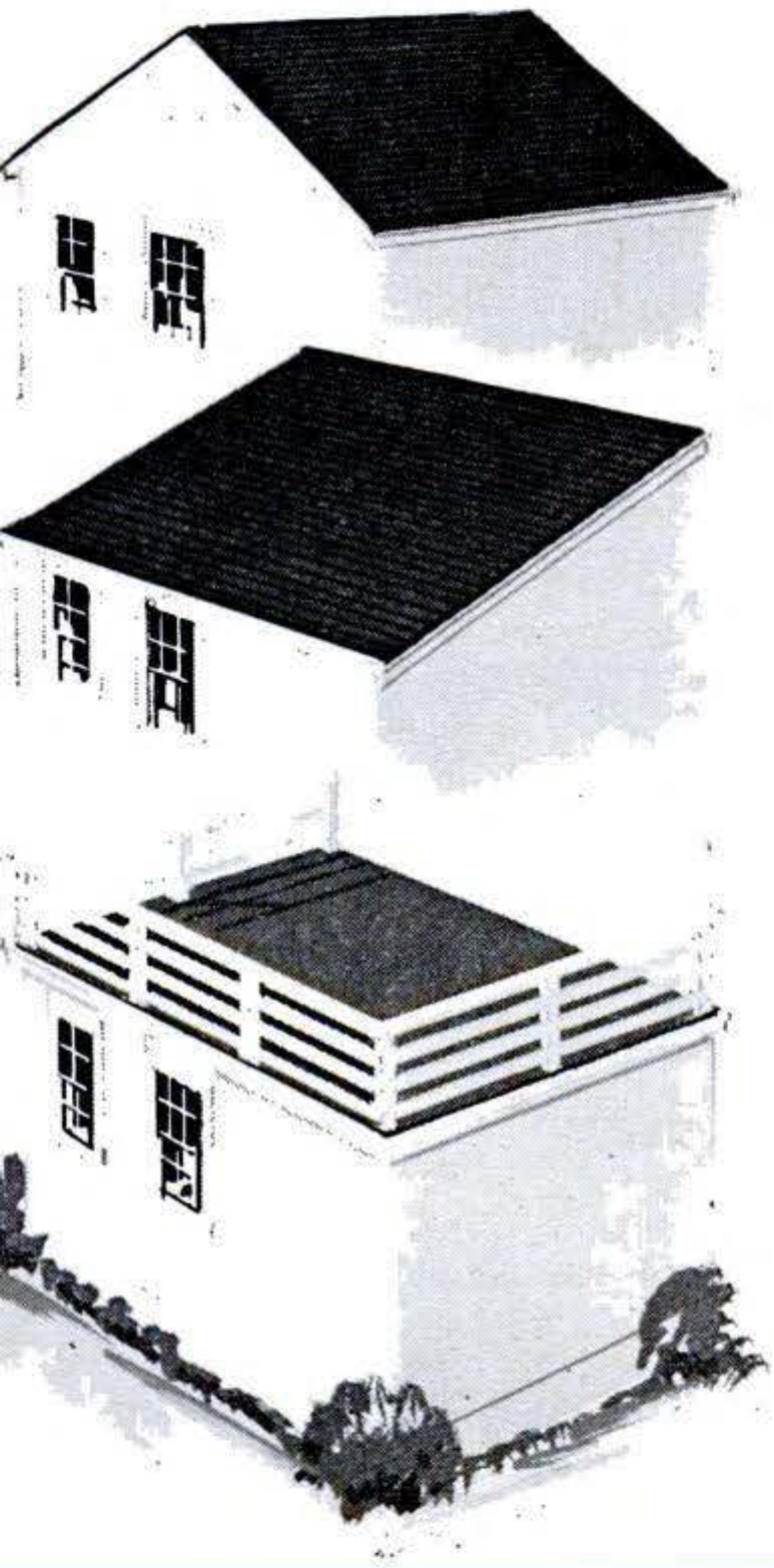

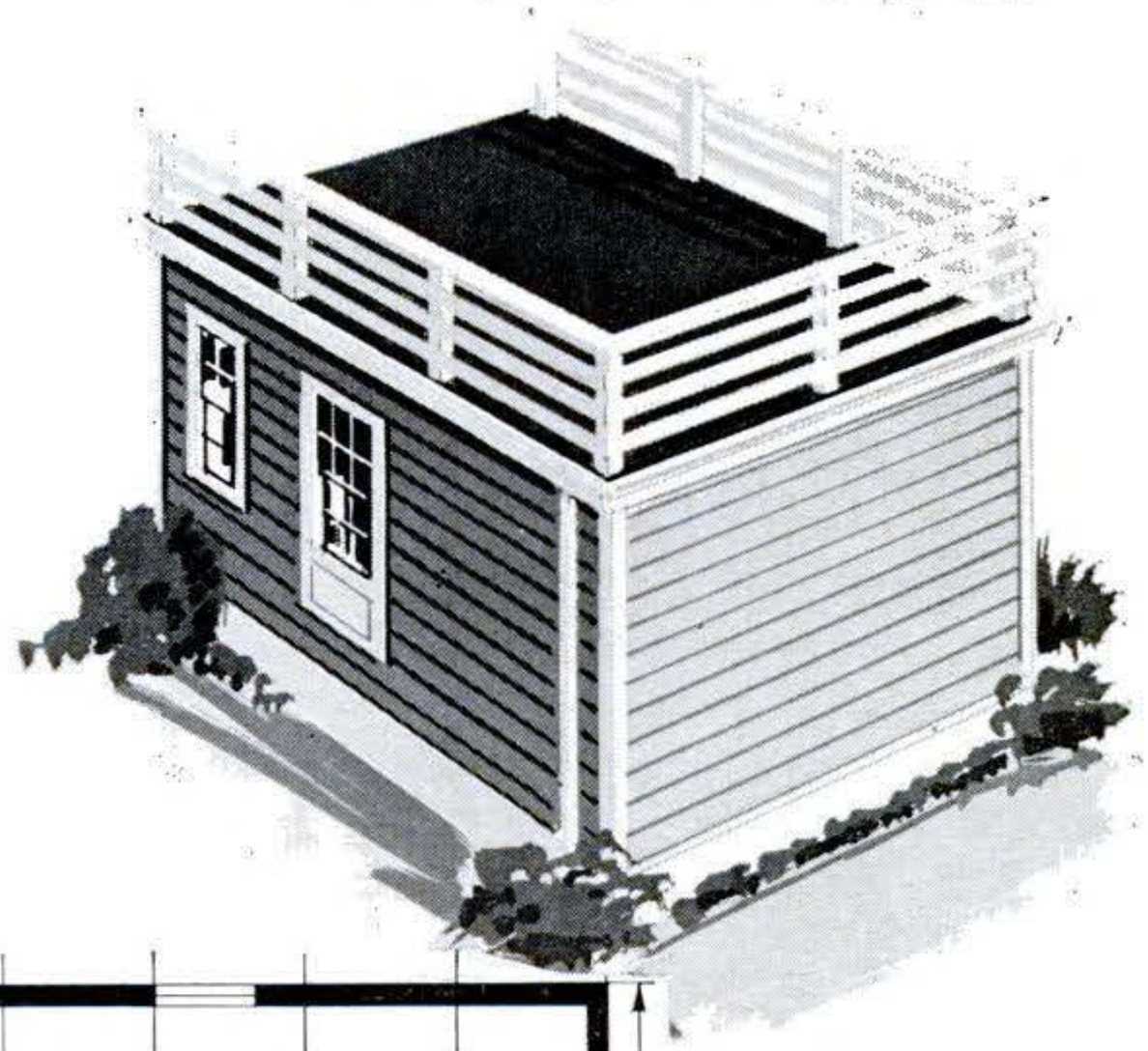

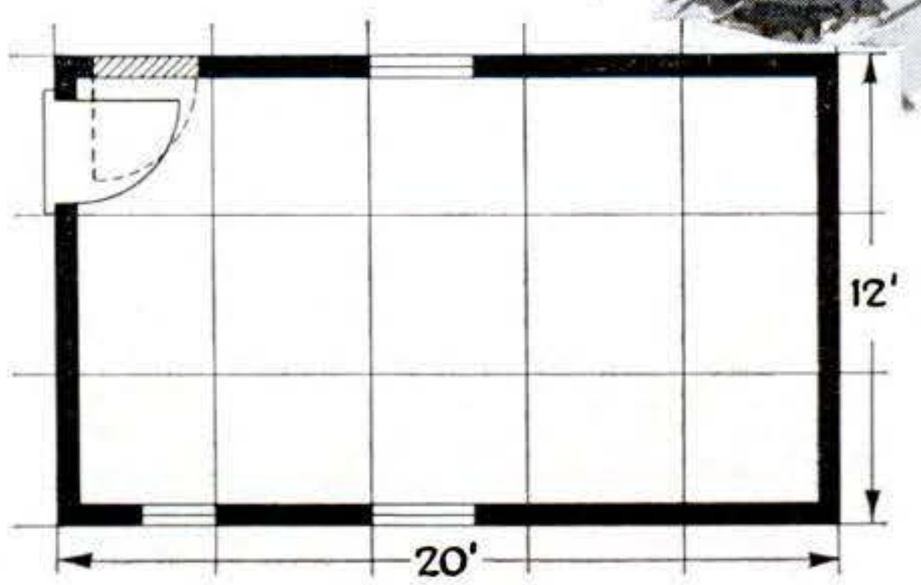

Attach rectangular rooms to a house by either the long or short side. The three roof styles let you fit one of these rooms to your house's style.

or It Can Be RECTANGULAR

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How you can modify one of the modular additions to suit your own house

A polyethylene vapor barrier laid on the earth and partly up the sides of the foundation walls prevents condensation on the joists and helps keep insects out.

A two-by-six sill is held by bolts embedded in the foundation walls 8′ on center, or in cement-filled openings in the block. Heavy galvanized mesh or expanded metal at joints under the blocks into which the anchor bolts will be embedded will hold the cement. The ⅝″-by-20″ bolts, threaded ends up, should project above the foundation wall about 3″.

Put a termite shield of sheet aluminum between the top of the foundation wall and the sill. Extend it an inch or more on each side of the wall and bend the ends down 45 degrees.

The two-by-eight joists are toenailed to the sill and held on edge with cross bridging. Over the joists nail ½″ CD or CS plywood subflooring. Around the edge of the floor nail a two-by-four sole plate, to which the studs are nailed. Better yet, use zinc-coated sheet-metal anchors for the studs.

Note also, on the framing elevations, one-by-three diagonal bracing which must be let into the studs.

Horizontally above the studs, nail two two-by-four plates as a base for the ceiling joists. Space the joists 16″ on center and use cross bridging every 8′.

For outside sheathing, use one-by-eights applied diagonally, or ½″ CD plywood sheathing. Cover the sheathing with building paper and put on the siding.

For best appearance, use the same kind of siding as is on your house. Frame in and enclose the room before erecting the inside partitions. Some ideas on how both rooms can be divided are illustrated, but you may

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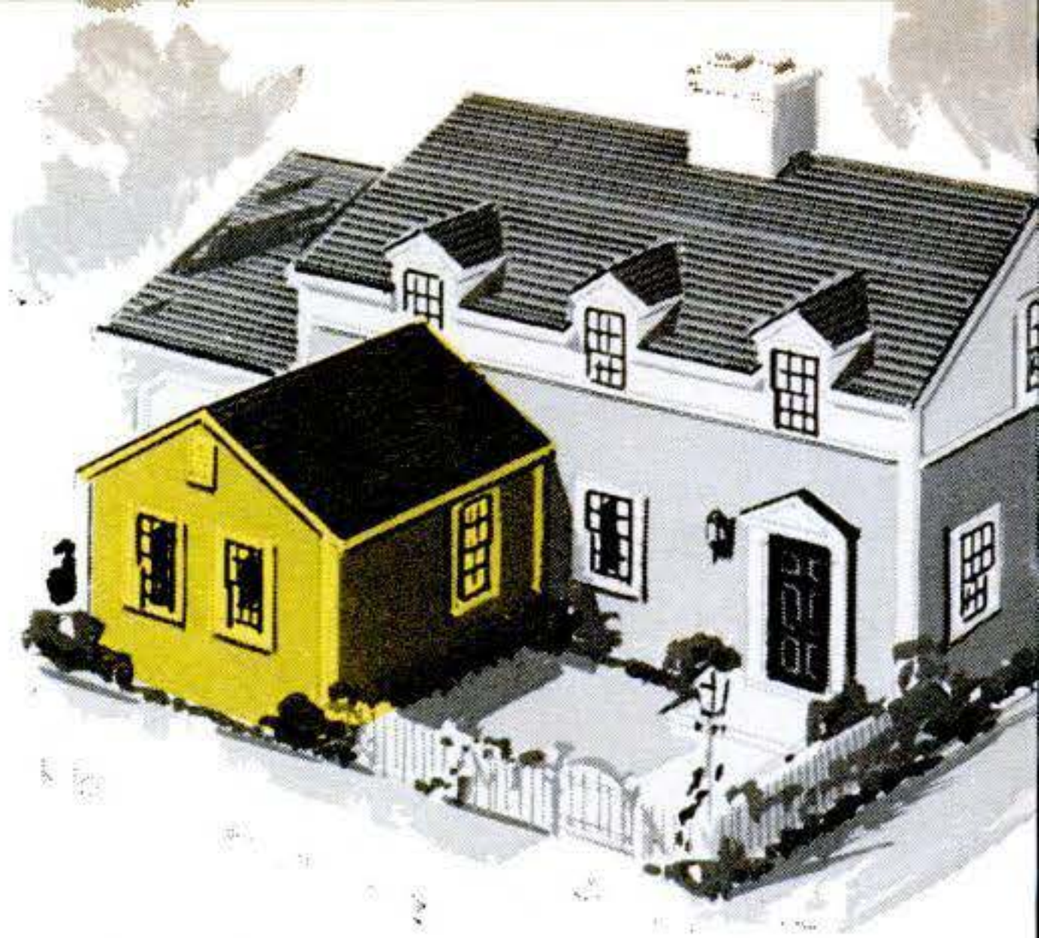
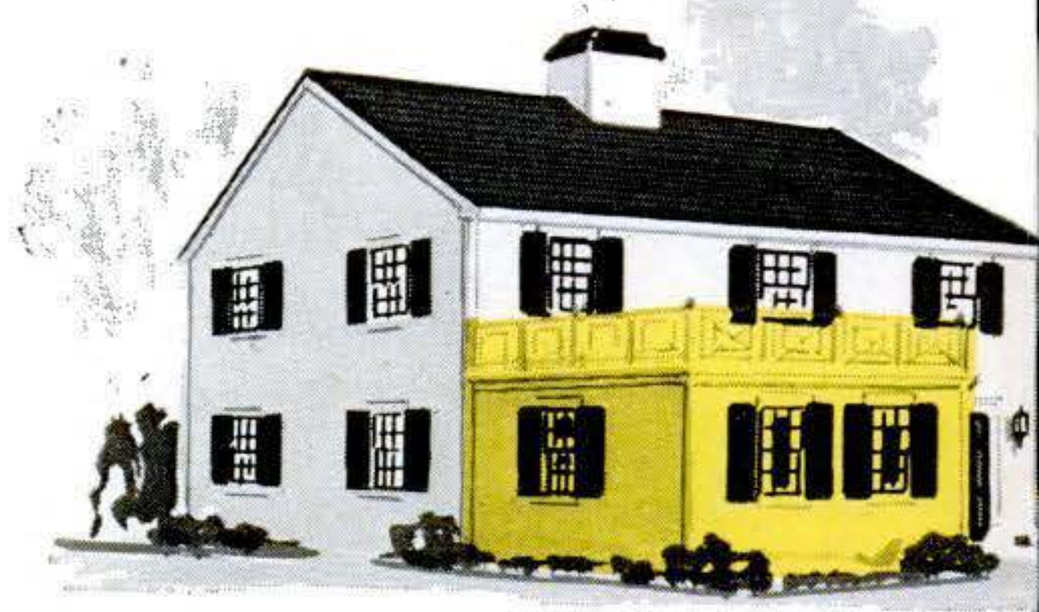


When adding a room at front, check building cod to see how near to the property line you can bui

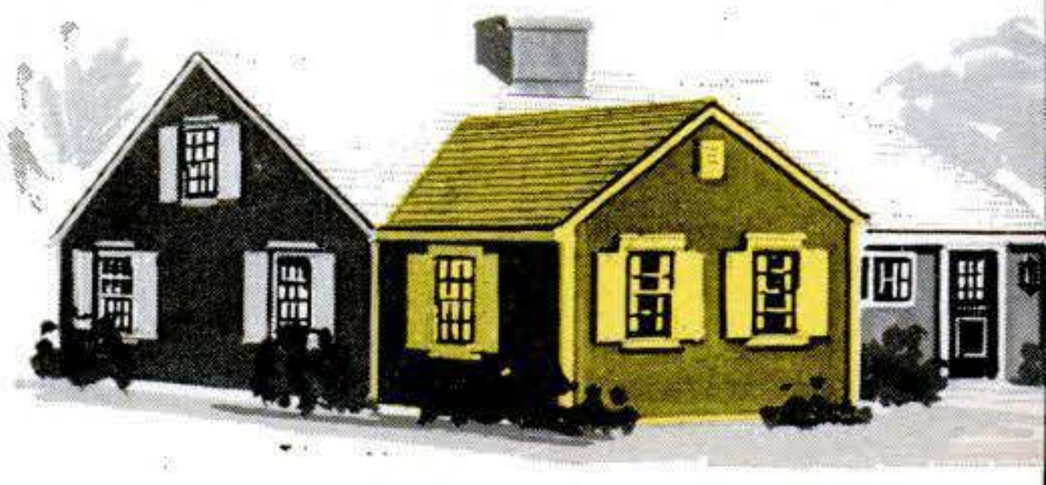


For privacy and quiet, build on at the back of the house. Here, the flat roof provides a sun deck, too.

Door room is all the space you need to conne a new addition. Enlarging a window makes a doo

Most desirable spot for a new room is the side of house. Pitch the roof the same as the house roof.

Low-eave Cape Cod takes a square addition. If po sible, locate the new room near the house plumbin



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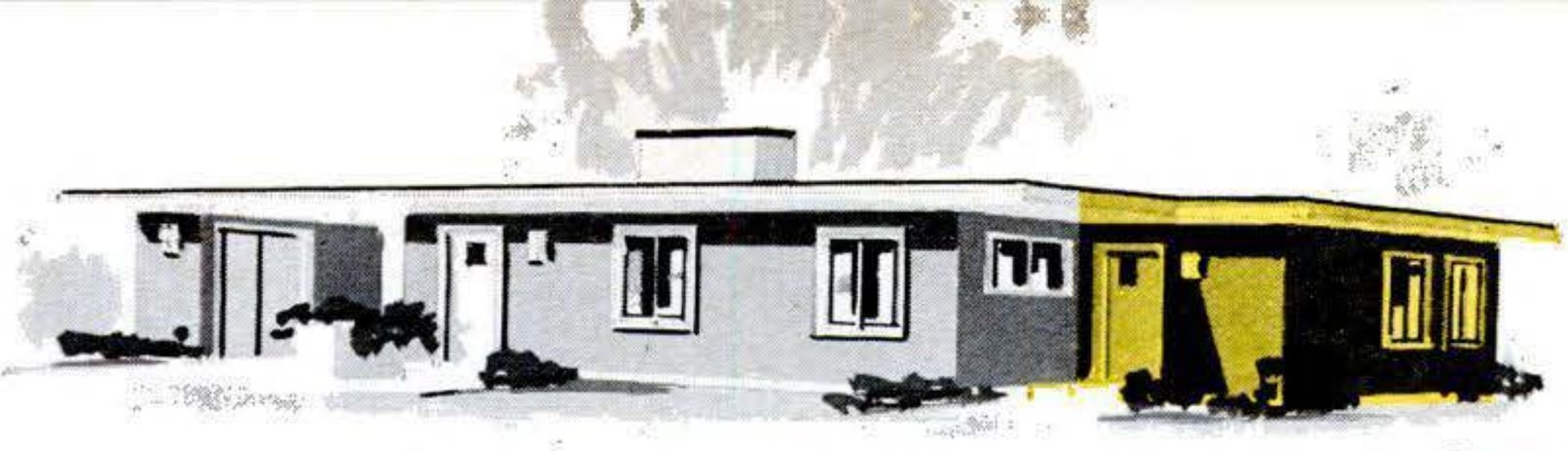
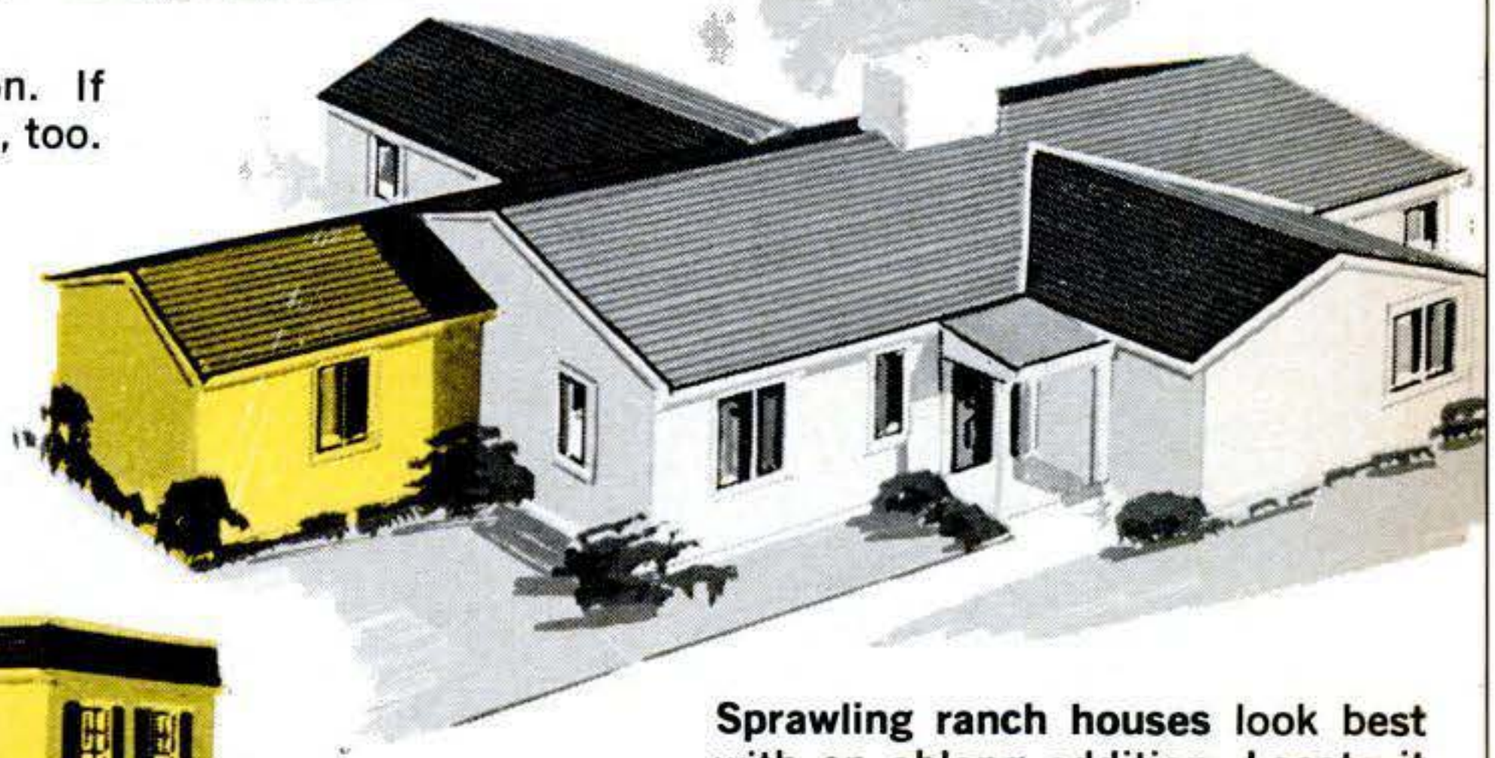
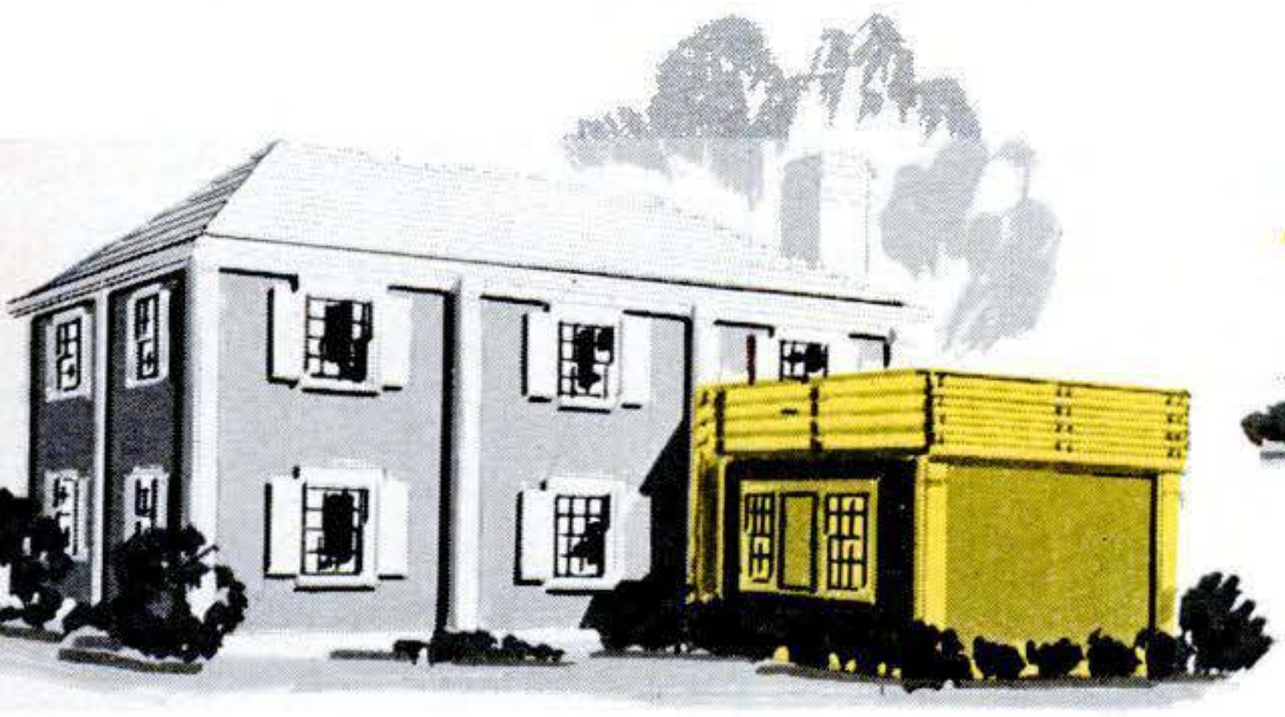


Flat-roof houses call for a flat-roof addition. If you have a slab floor, use one for the new room, too.



Sprawling ranch houses look best with an oblong addition. Locate it carefully. Don't cover windows needed for light and air.

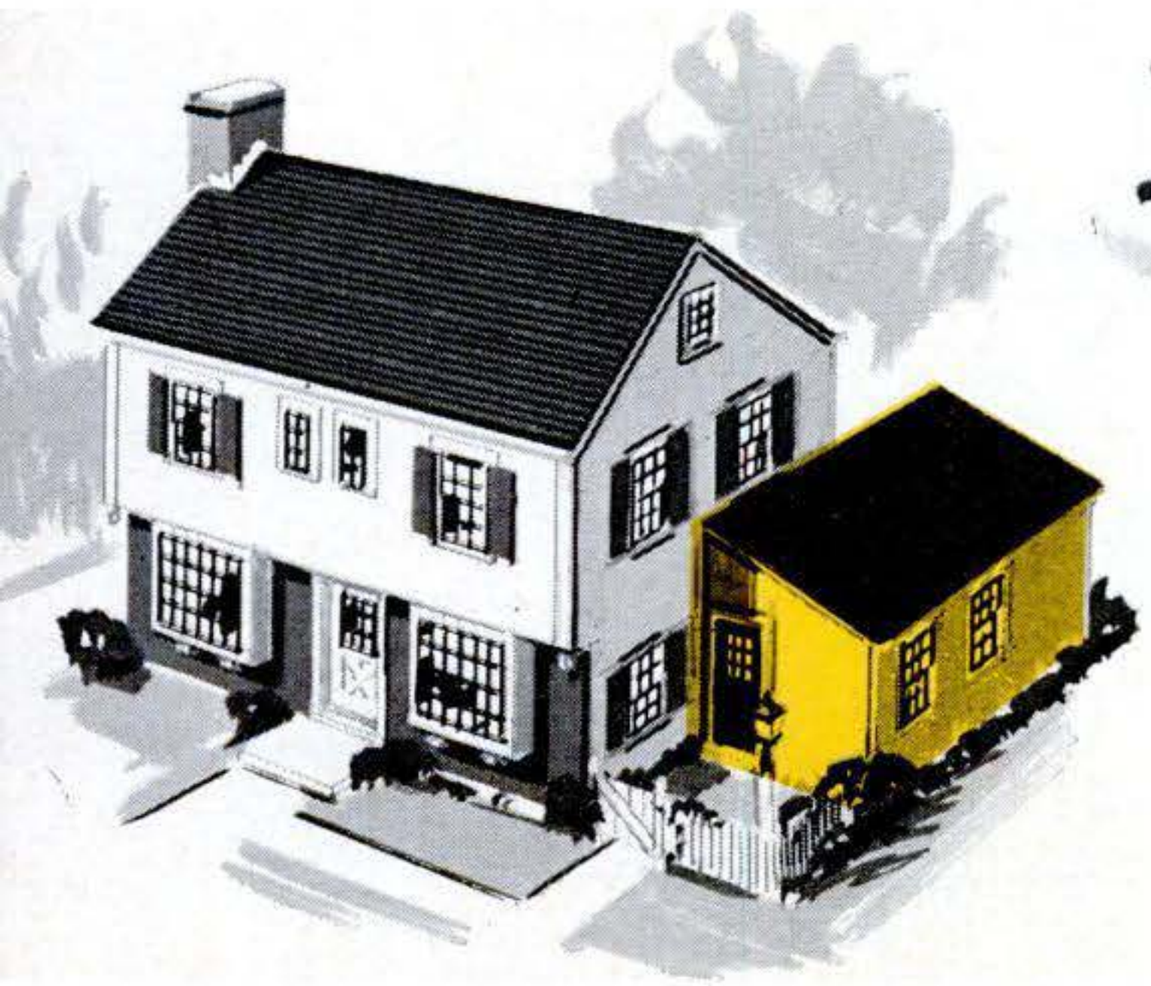
Shingled railing on this flat roof addition matches the house roof. Windows and shutters also match.

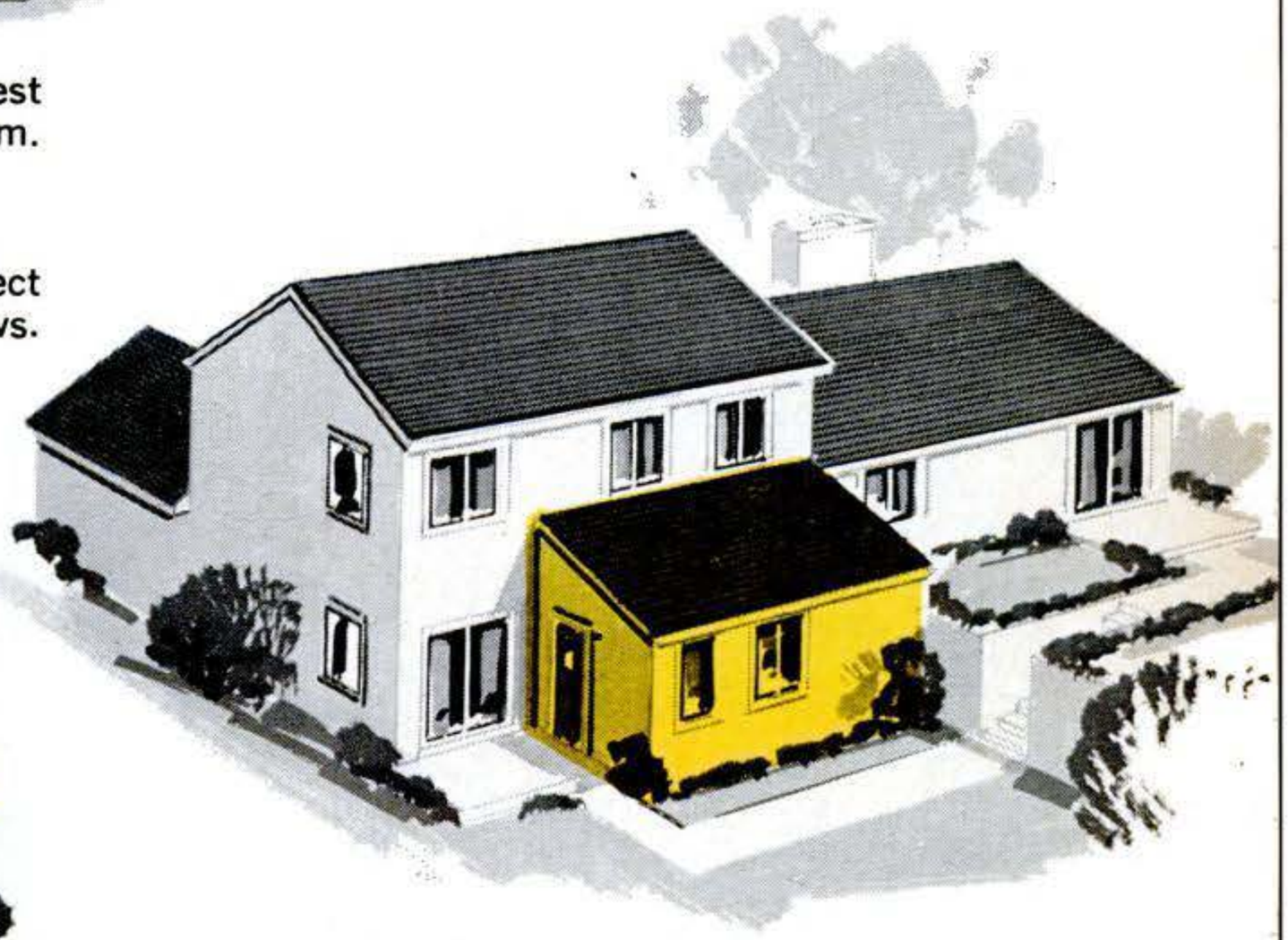


New England Regency houses with short front and long side need a rectangular room, as shown above.

Greek Revival houses divided by pilasters look best when one section is used as a side for the new room.

Only part of the wall of the new room need connect to the house. Keep new roof below upstairs windows.





A split-level house can usually take a new room next to the basement recreation room. Another way: Connect it with a short hallway.

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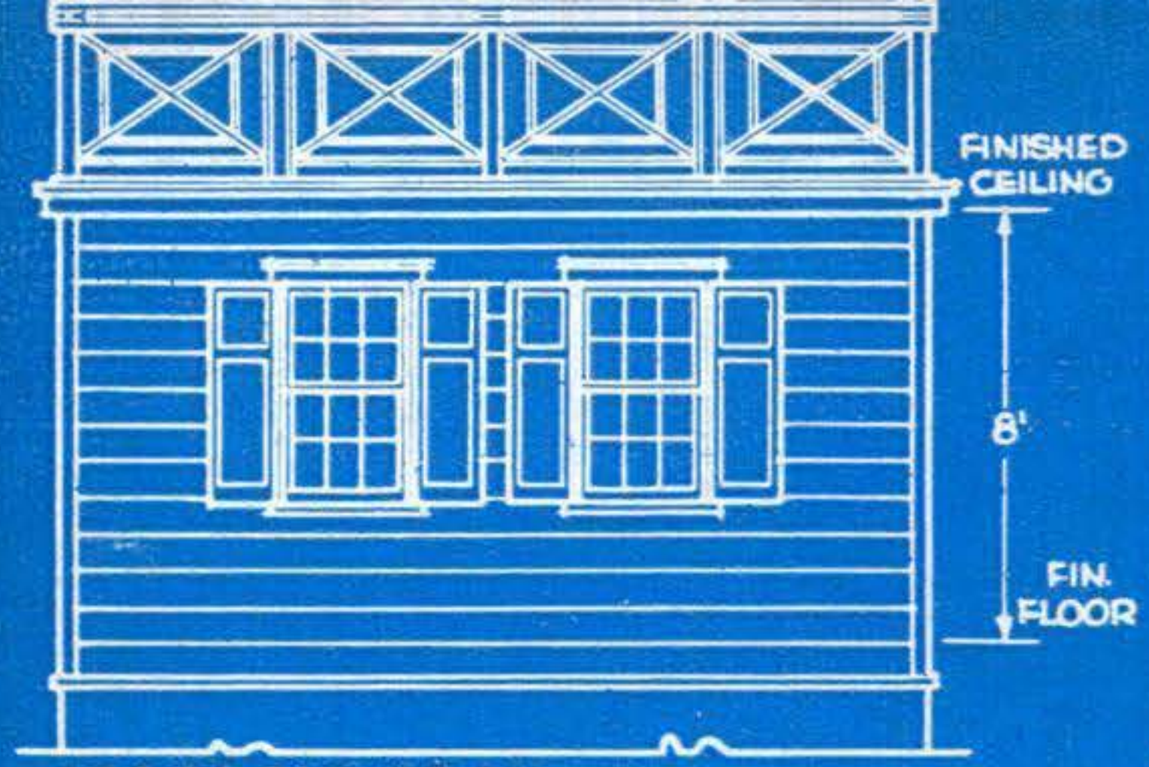
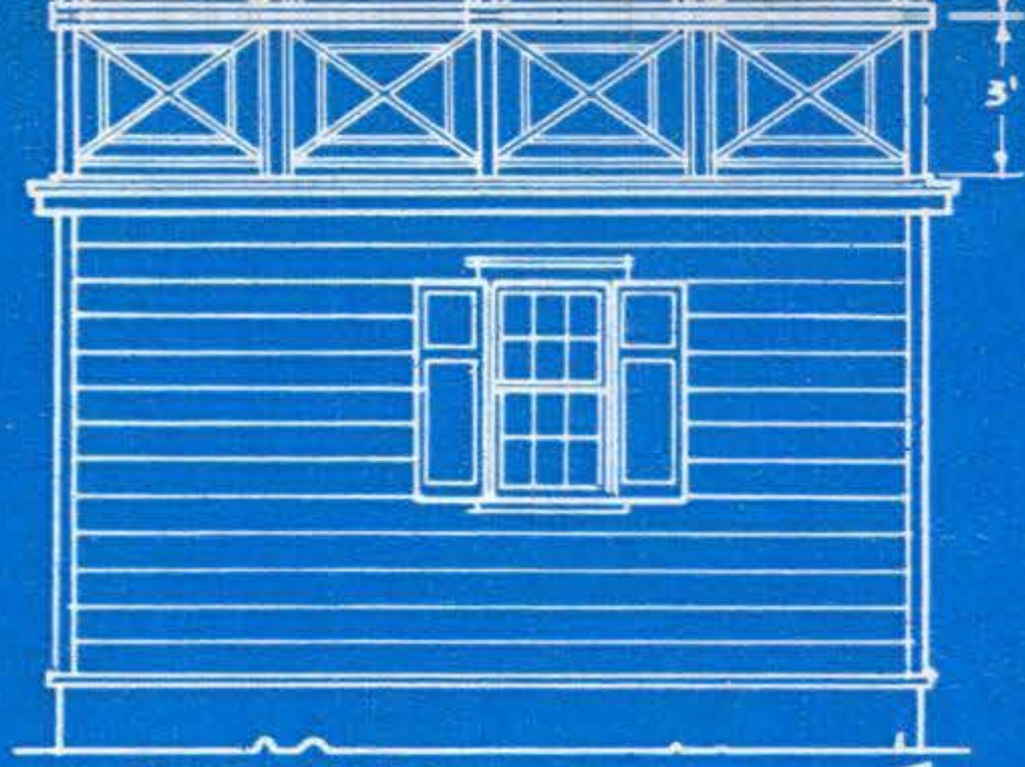
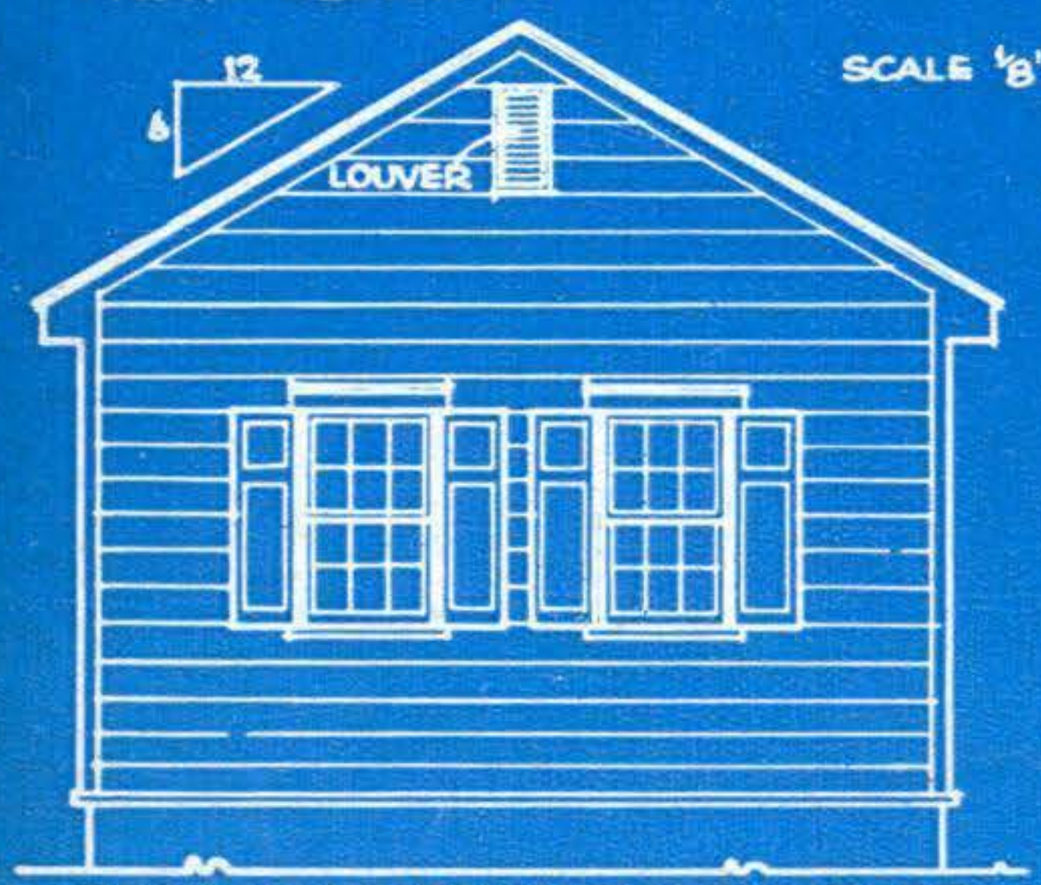


FRONT ELEVATION

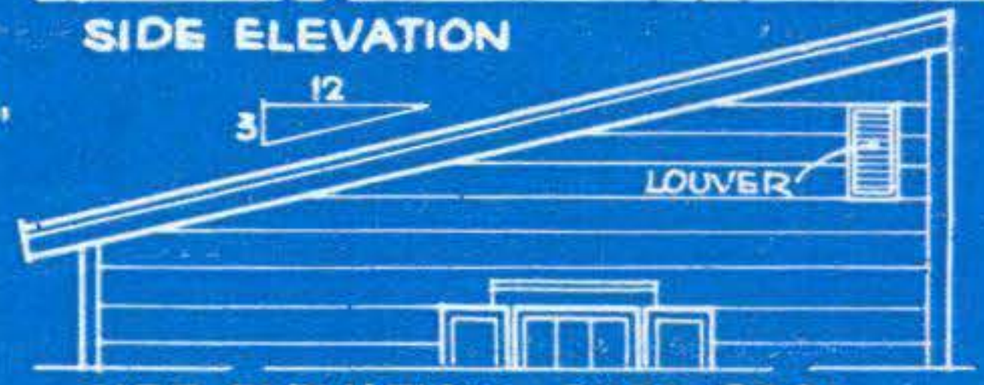


SIDE ELEVATION

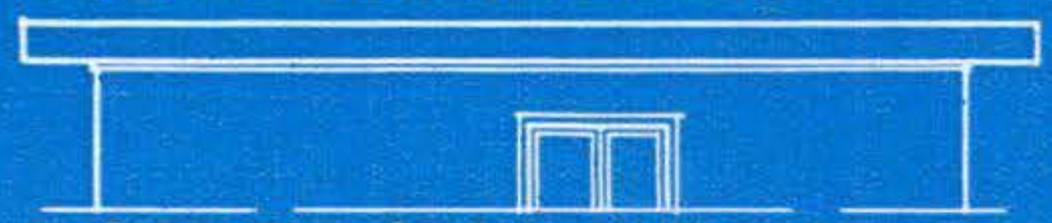
SCALE 1/8" = 1' 0"



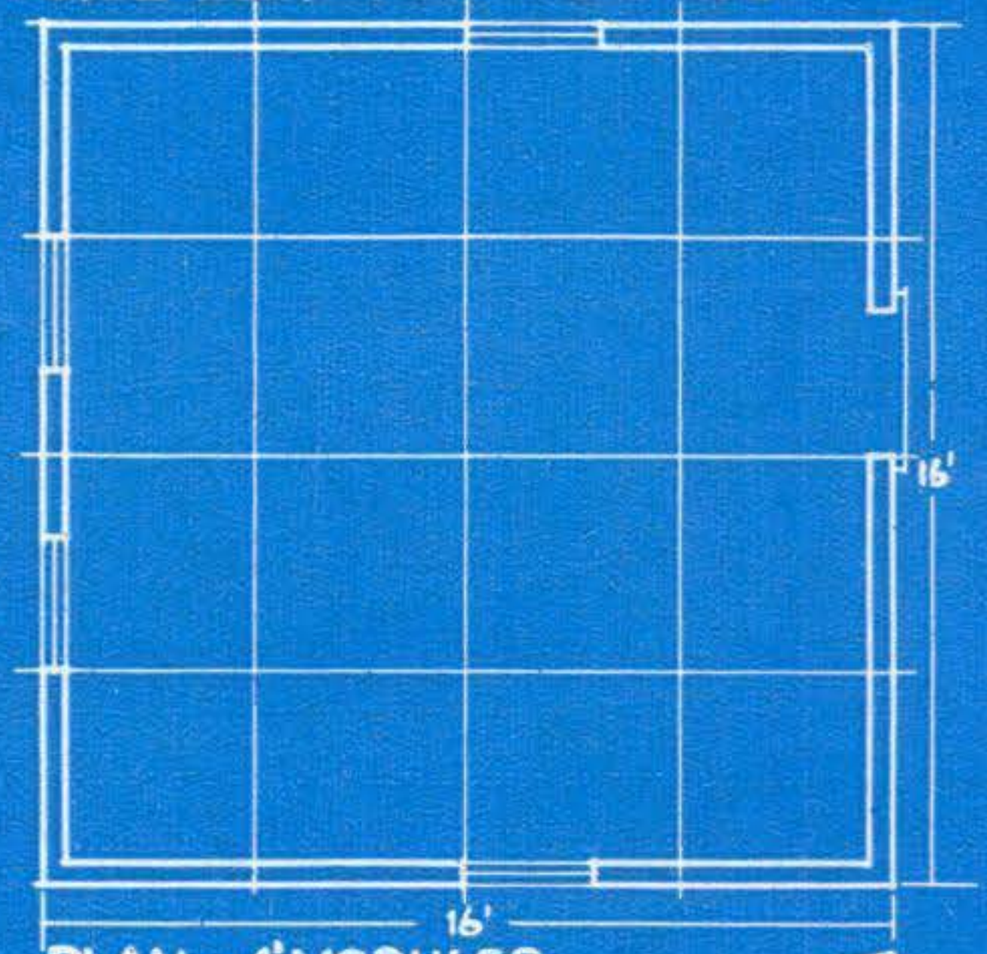
FRONT ELEVATION - GABLE ROOF



SIDE ELEVATION - SHED ROOF

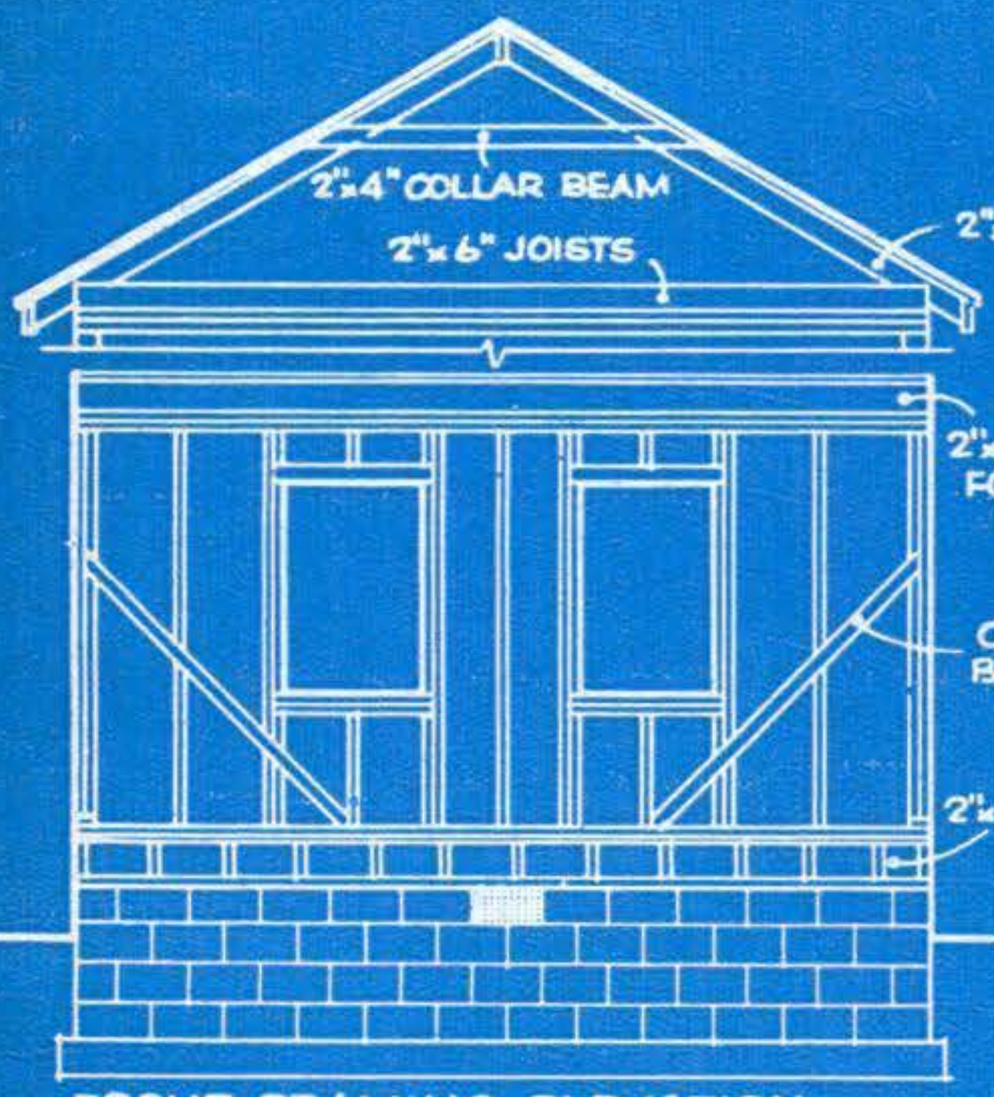


SIDE ELEVATION - FLAT ROOF

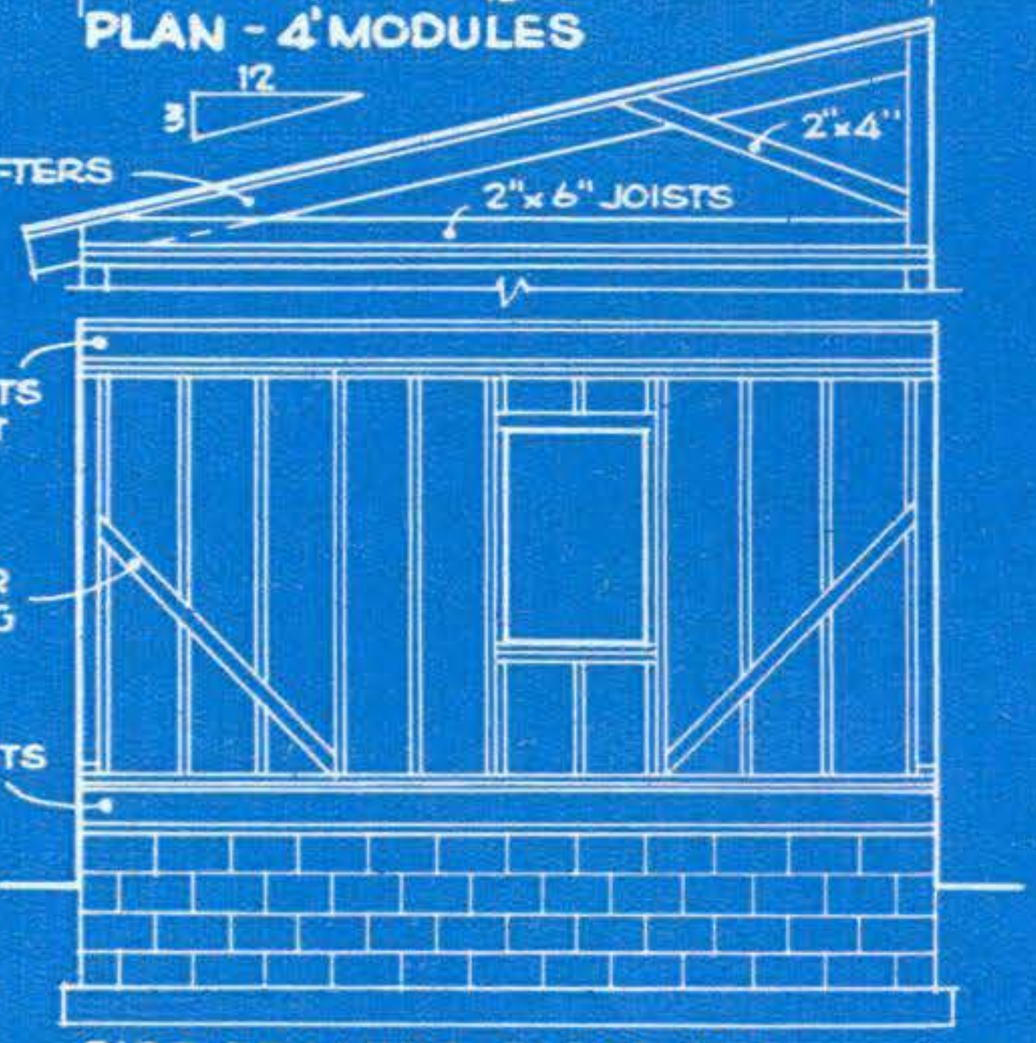


PLAN - 4' MODULES

Like a complete blueprint (plus a bill of materials) by a registered architect, suitable for filing with your local authorities or on which a builder can make bids? For $5, you can get detailed blueprints for both of the basic rooms shown here. Send check or money order to Two Basic Rooms, Popular Science, 355 Lexington Ave., New York, N. Y. 10017. Print your name and address clearly.



FRONT FRAMING ELEVATION
GABLE ROOF

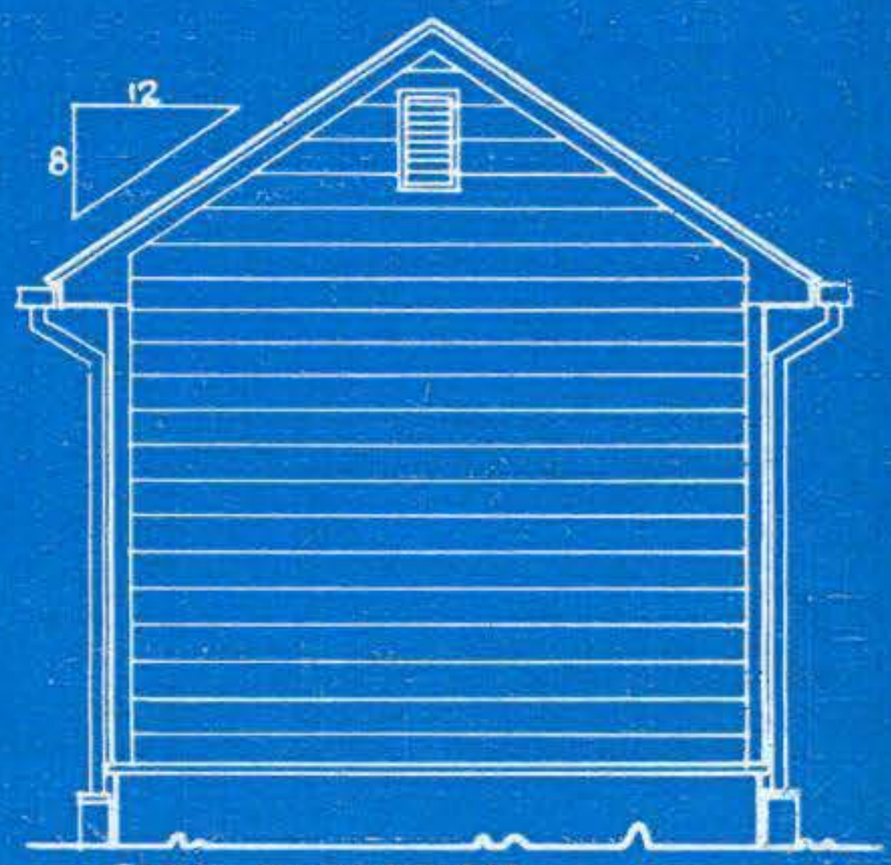


SIDE FRAMING ELEVATION
SHED ROOF

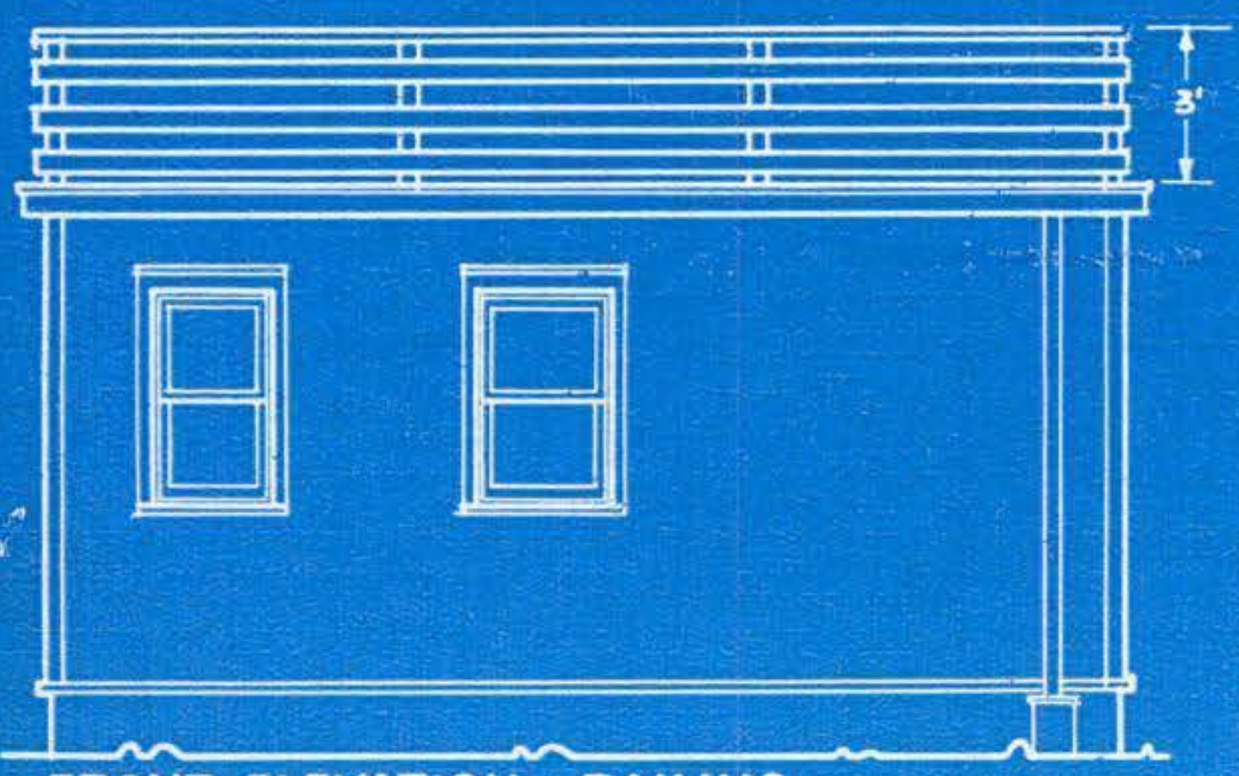
PS LIE-FLAT BLUEPRINT

TWO BASIC ROOMS

FRONT ELEVATION - GABLE ROOF

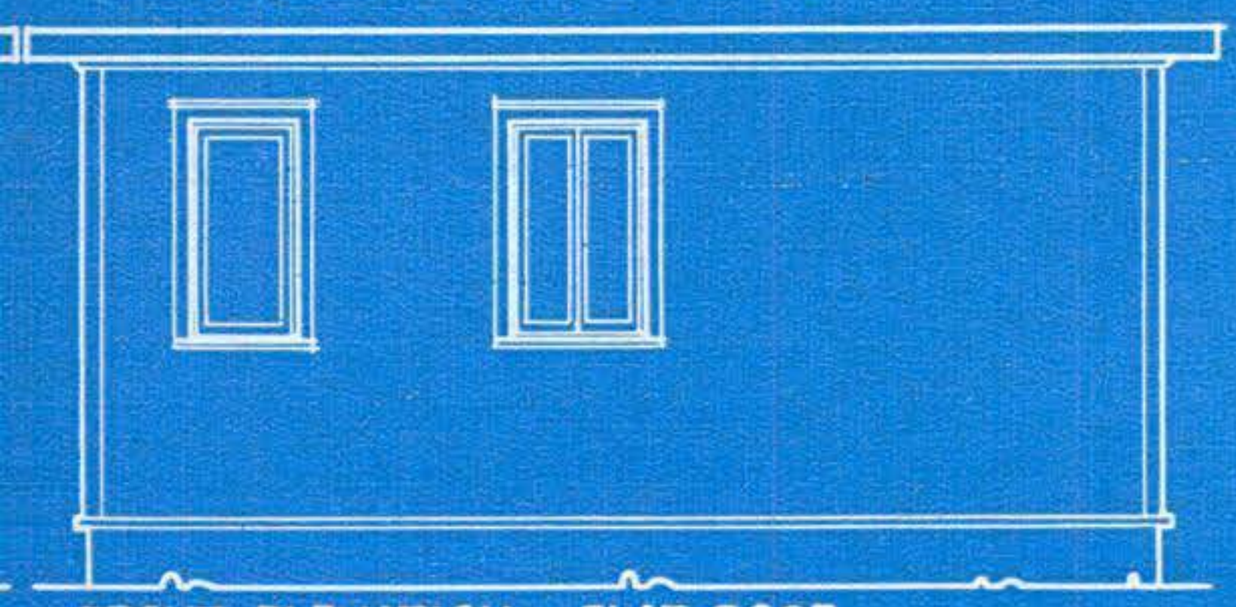


SIDE ELEVATION

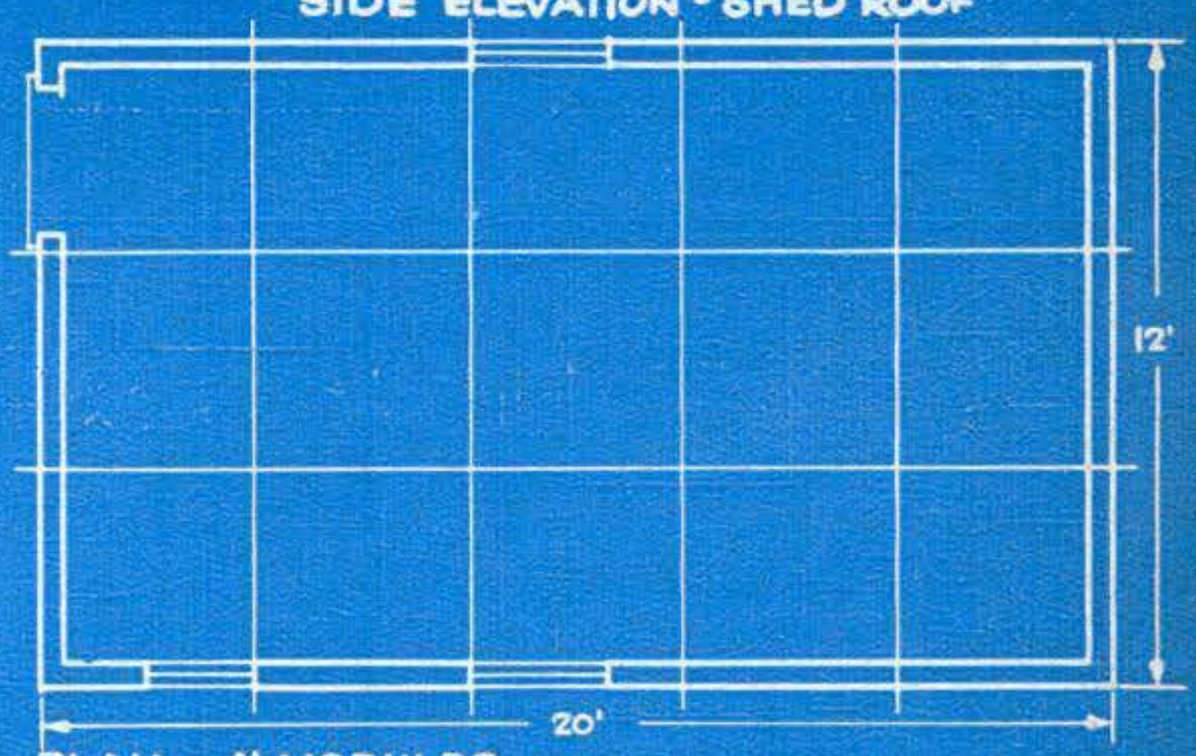


FRONT ELEVATION - RAILING

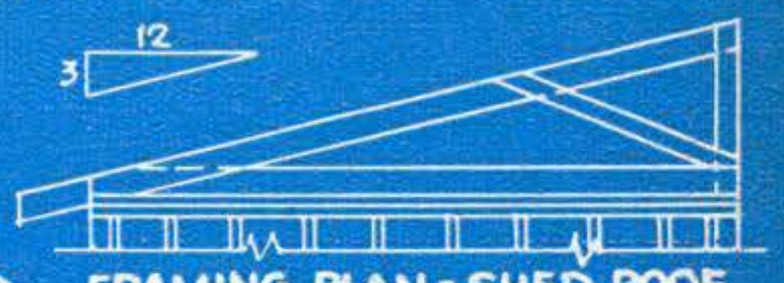
SIDE ELEVATION - SHED ROOF



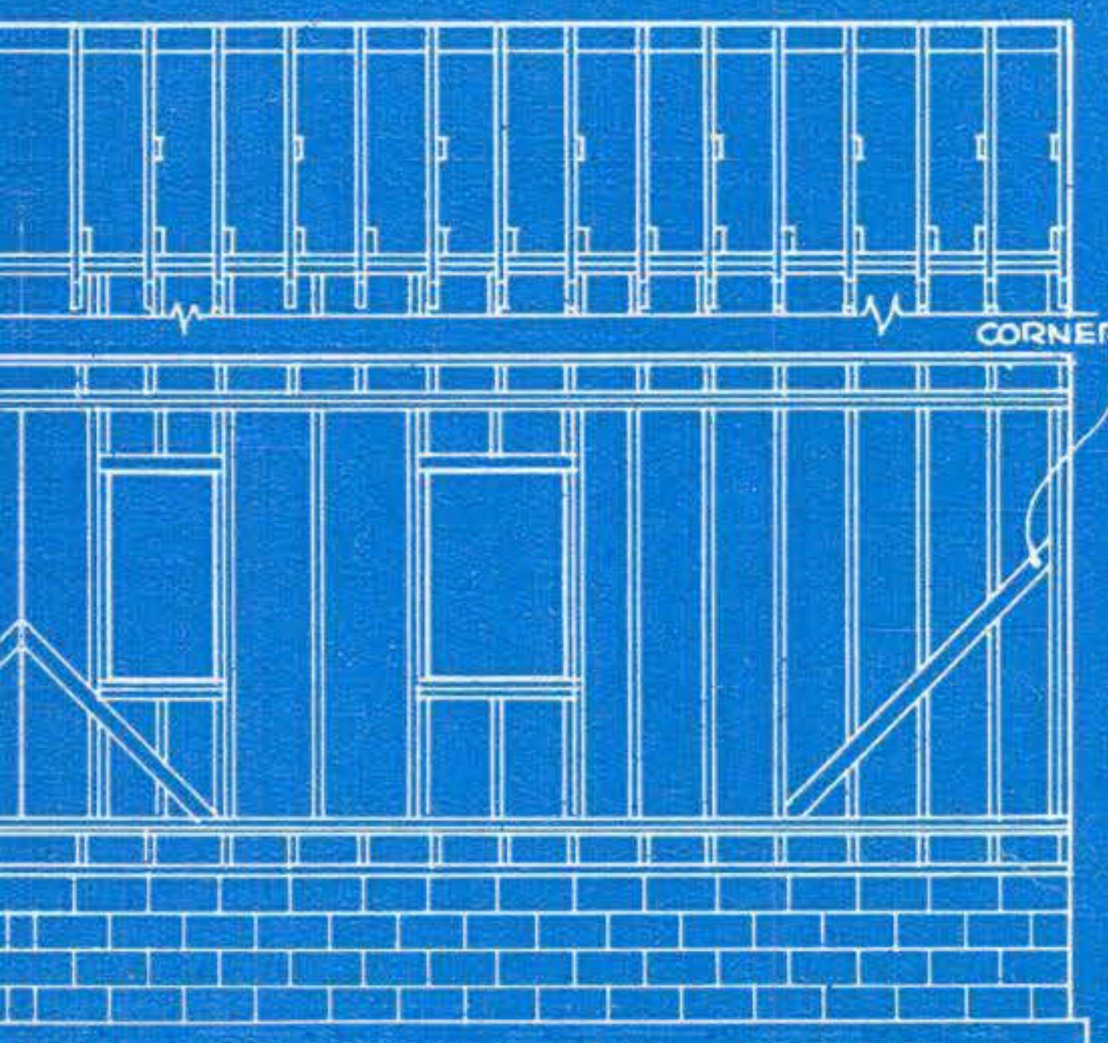
FRONT ELEVATION - FLAT ROOF



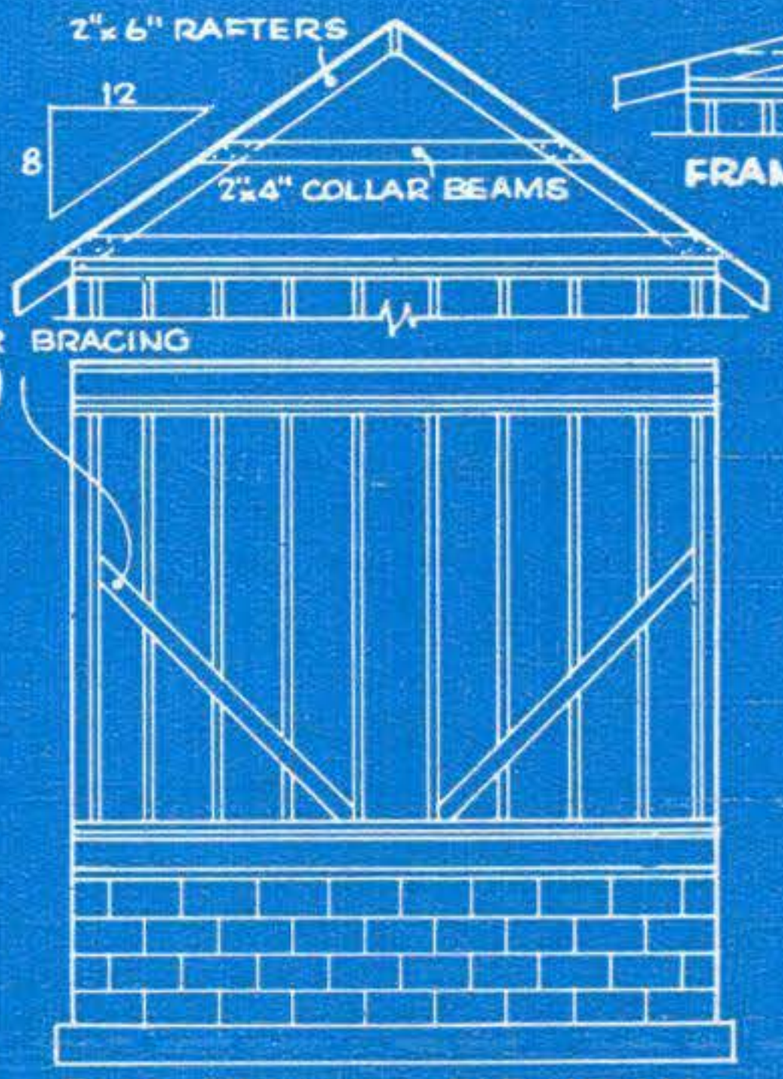
PLAN - 4' MODULES



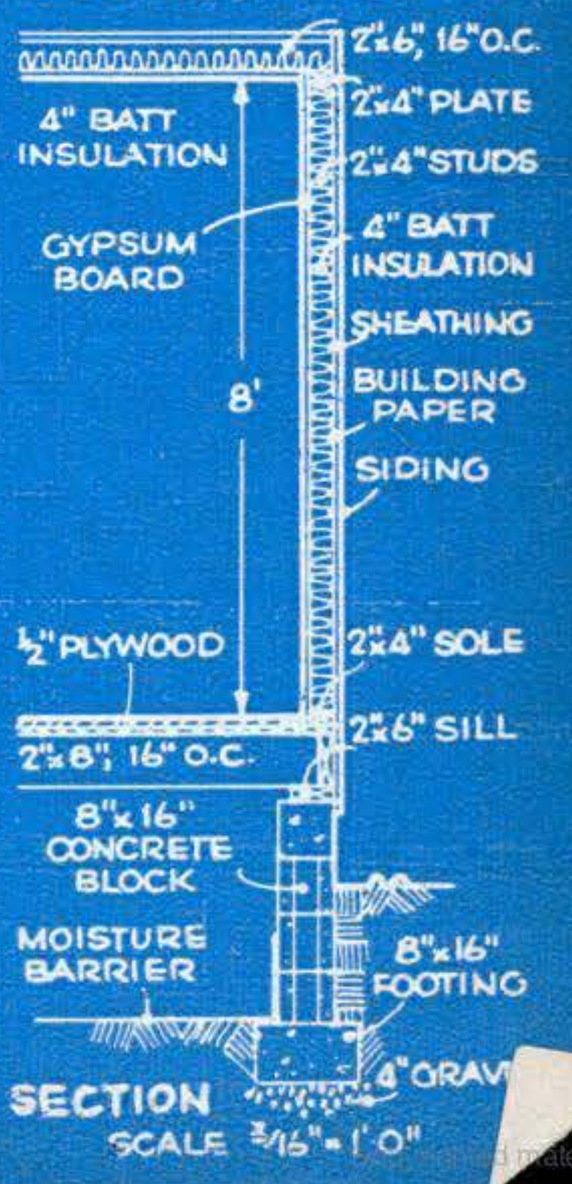
FRAMING PLAN - SHED ROOF



FRONT FRAMING ELEVATION



SIDE FRAMING ELEVATION



SECTION
SCALE 3/16" = 1'-0"

have ideas of your own. If so, lay out your arrangement to scale on graph paper. Also draw to scale the furniture in each room.

Use two-by-six rafters for the gable and shed roofs; put collar beams across every pair of rafters on a gable roof or ties on a shed roof. Notch the rafters to fit over the plates, then spike the ceiling joists to the rafters. Sheathe the roof with ½″ CS plywood. Over this put roll felt, then composition or wood shingles. Instead of plywood sheathing you can, of course, use 1″-by-8″ roofers or ½″ weather-tight composition sheathing without underlayment.

For roofs of less than 4-12 pitch, shingles should not be used because wind and rain can get under them. A low-pitched shed roof or a flat roof should be made of built-up roll roofing.

If you're doing the work yourself, you'll save time and effort by buying both windows and doors as complete units. Some doors now come in a frame you can quickly install in an opening you have left in the house framing. Some modern window units include storm and screen elements already built in. If you buy both the windows and doors in advance, you'll know what size to make the openings. You should install them before the siding is on.

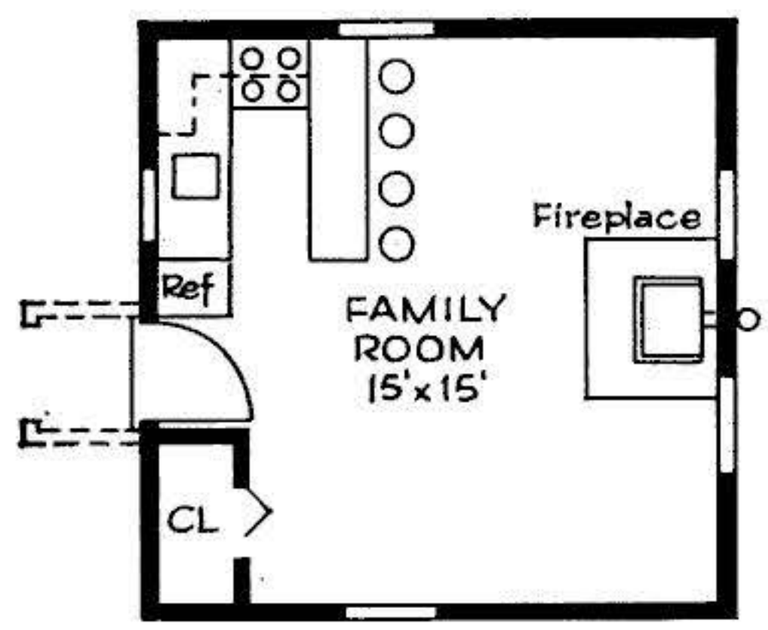
Be sure to use double studs around window and door openings, as well as double lintels and sills. Install double lintels on edge for greater strength.

Use batt insulation for both ceiling and walls. Always put the vapor seal toward the warm side of the room and staple the flanges to stud and rafters. A shed- or gable-roof addition needs ventilating louvers in the end walls, too.

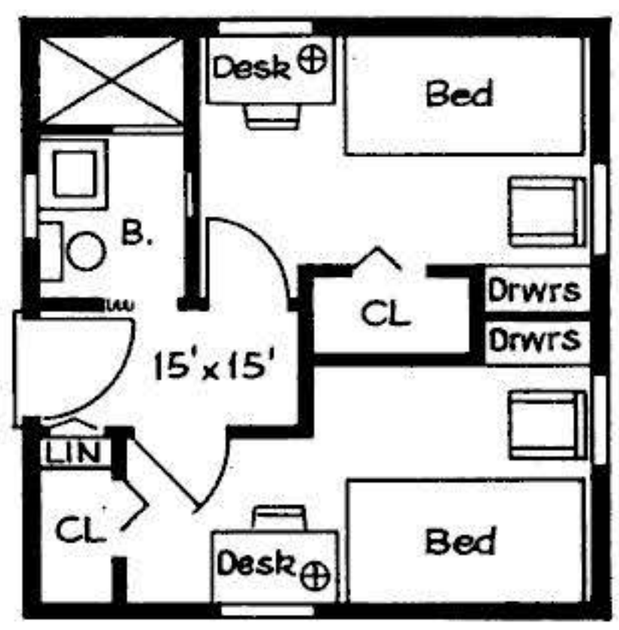
For the interior walls, use gypsum board or prefinished paneling. You can put these on yourself.

If your furnace has the capacity, heating can be brought in from the main house. If not, consider space heaters or electric heat. Ask electric-company engineers to estimate monthly costs. PS

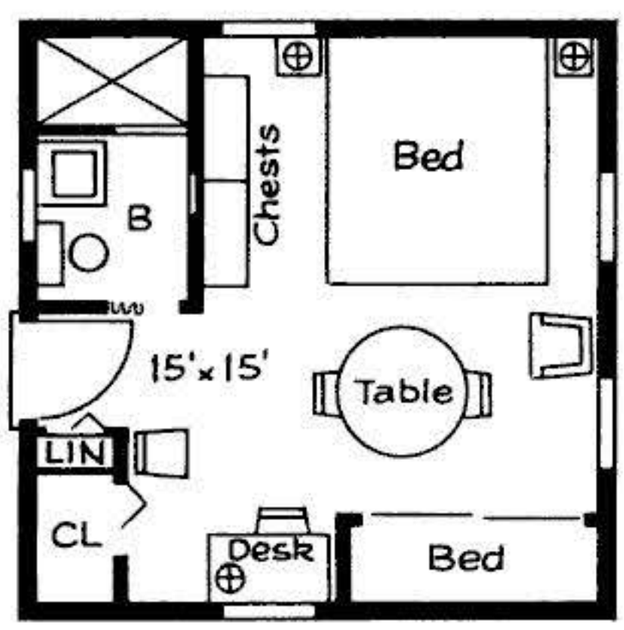
A few suggestions on how to arrange the square addition inside



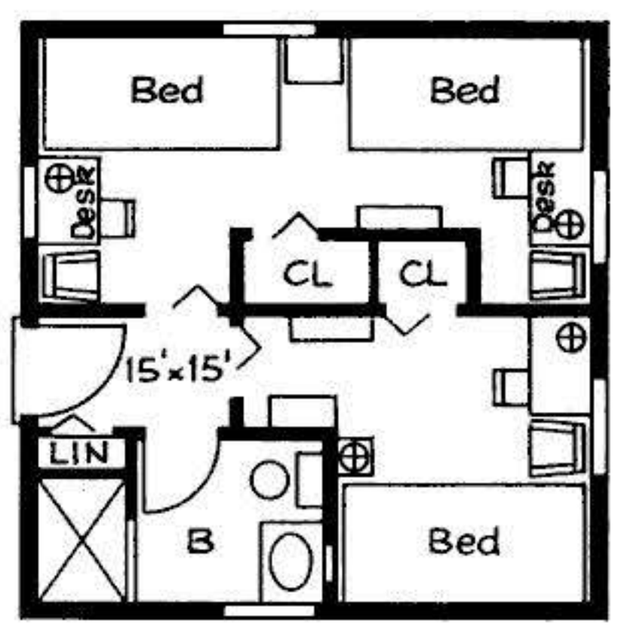
Recreation room laid out as above gives the family a place to gather and the children a place to play with friends.



Here's study and sleeping space for two children. Each child has the same area and ventilation. Bath is shared.

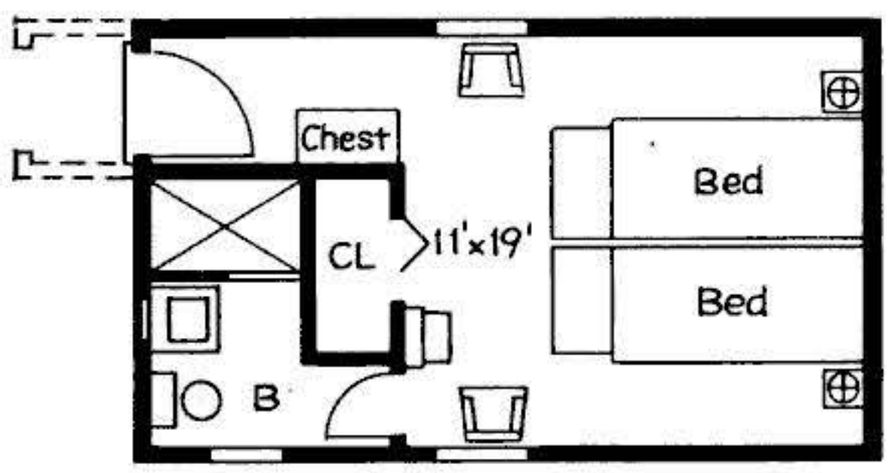


Master bedroom above has its own bath and lots of closet space for two. Table makes bedroom spot for hobbies.

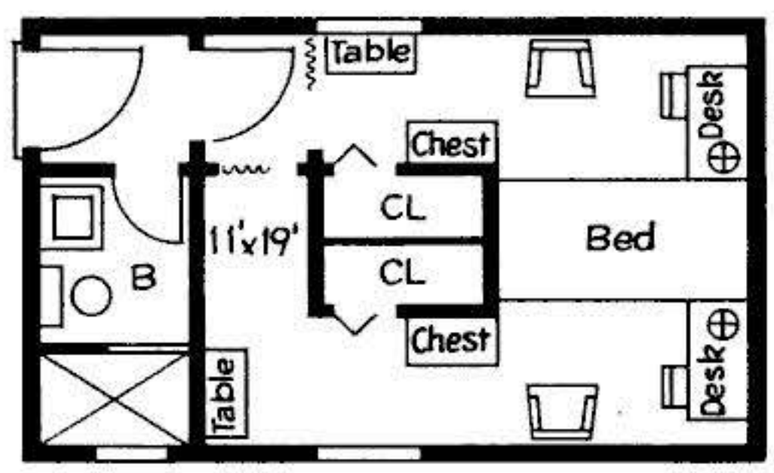


Two bedrooms arranged like this give three children a handy bath, ample closets, and a place for each to study.

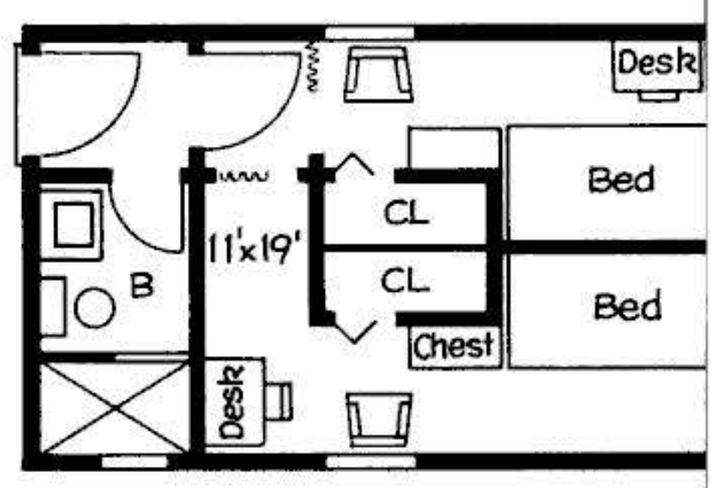
Here are some ways you can lay out the rectangular addition



Efficient layout makes a master bedroom, guest room, or room for retired parents, with its own bath and cross ventilation for comfort.



Double bunk in the middle of this addition is for sister and brother. The upper bunk opens into one room, lower bunk into the other.



Bedrooms for two people can be fitted into a 12′-by-20′ addition, with space left over for closets and a whole bathroom to share.

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How to Repair Your Toilet Tank

Part One

Pull-out Save-it SECTION

HOME-PLUMBING KNOW-HOW

By
GEORGE DANIELS
and
LOYD WEAVER

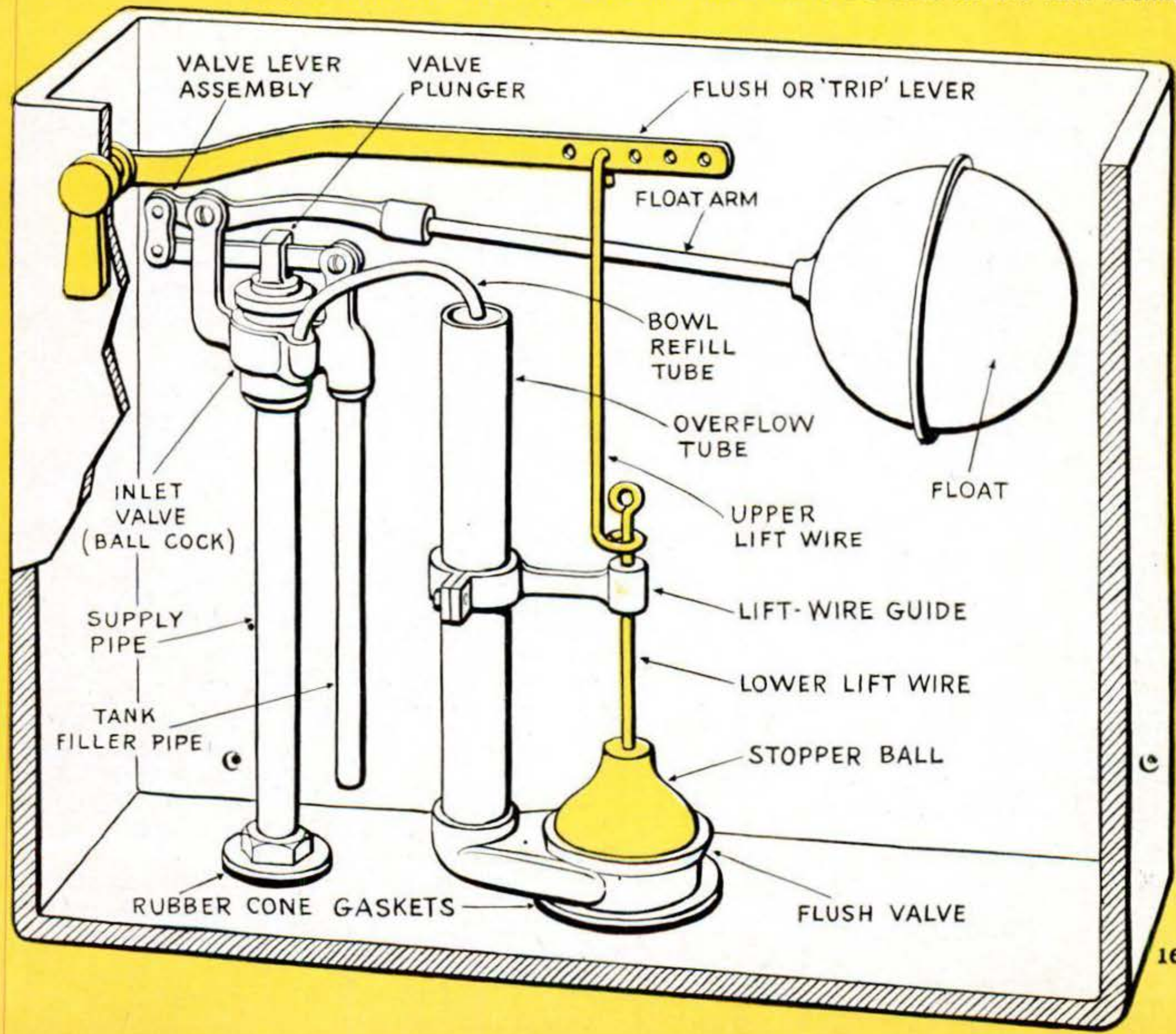
Even a simple plumbing job can wreck a household budget, and in an emergency expert help isn't always available. This new PS series will make you more self-sufficient. You can pull each article free from the magazine (pages now come out easily) and file it away.

The two authors know their subject thoroughly. George Daniels has written a book and many articles on plumbing. Loyd Weaver, a plumbing inspector, teaches plumbing theory to apprentice plumbers two nights a week under union auspices.

The series won't make you a plumber. You'll still need to call one at times. But, by showing you what can go wrong and corrective steps, the articles will be a key to do-it-yourself repairs.

Continued

What's inside a flush tank? There are two separate mechanisms. One (colored) empties the water into the bowl. The other refills the tank for the next flushing.



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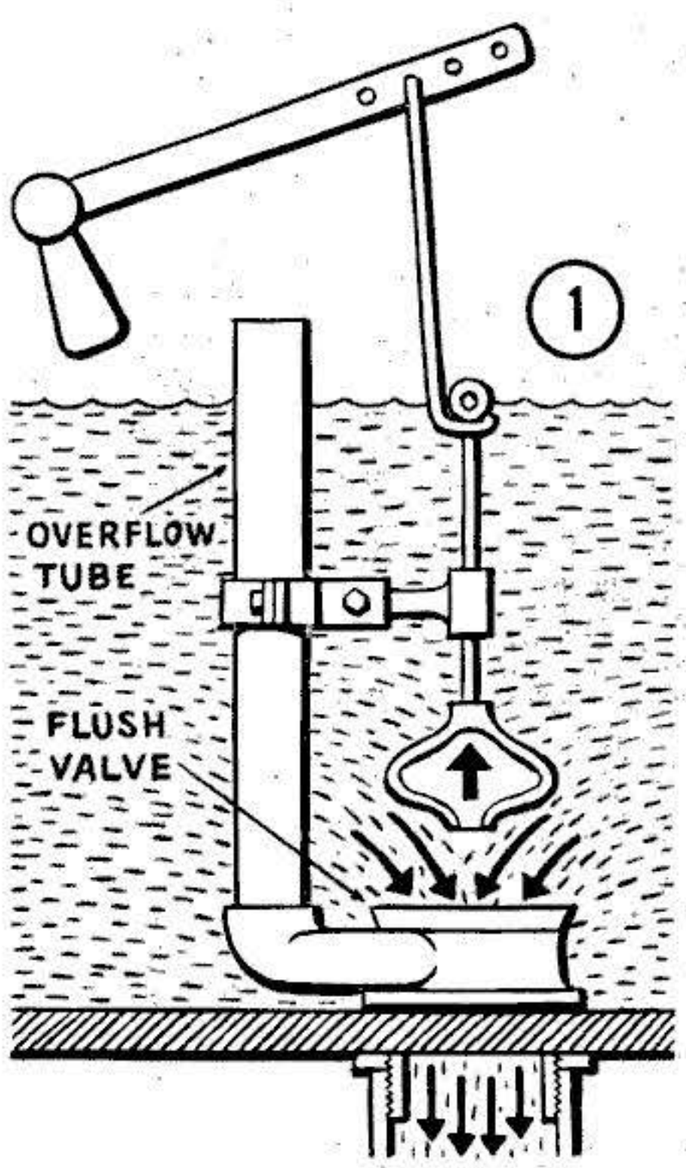
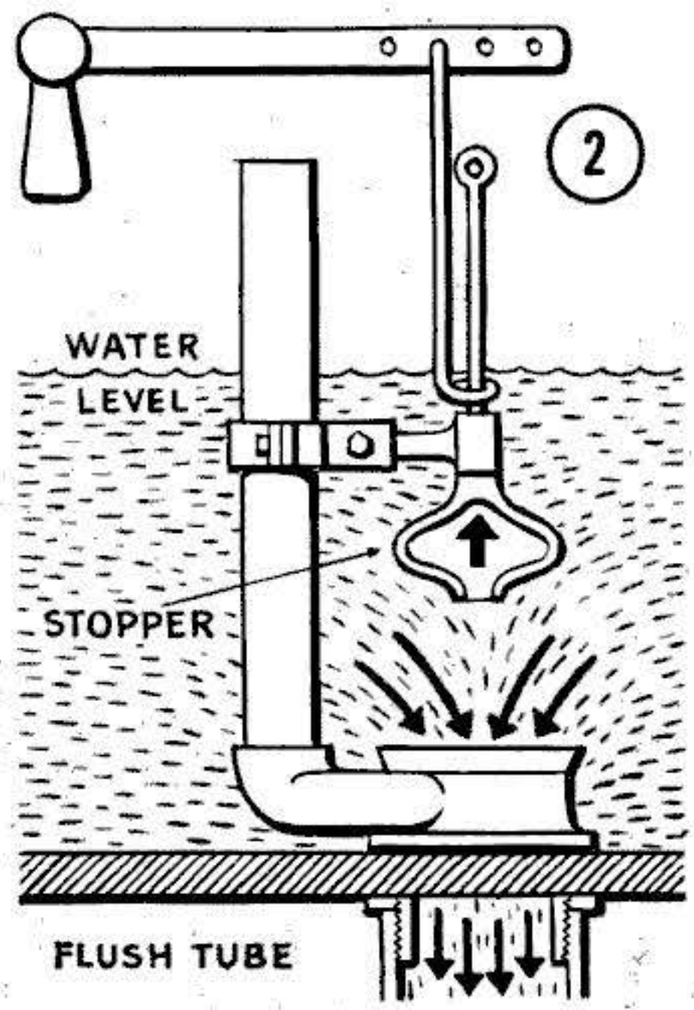
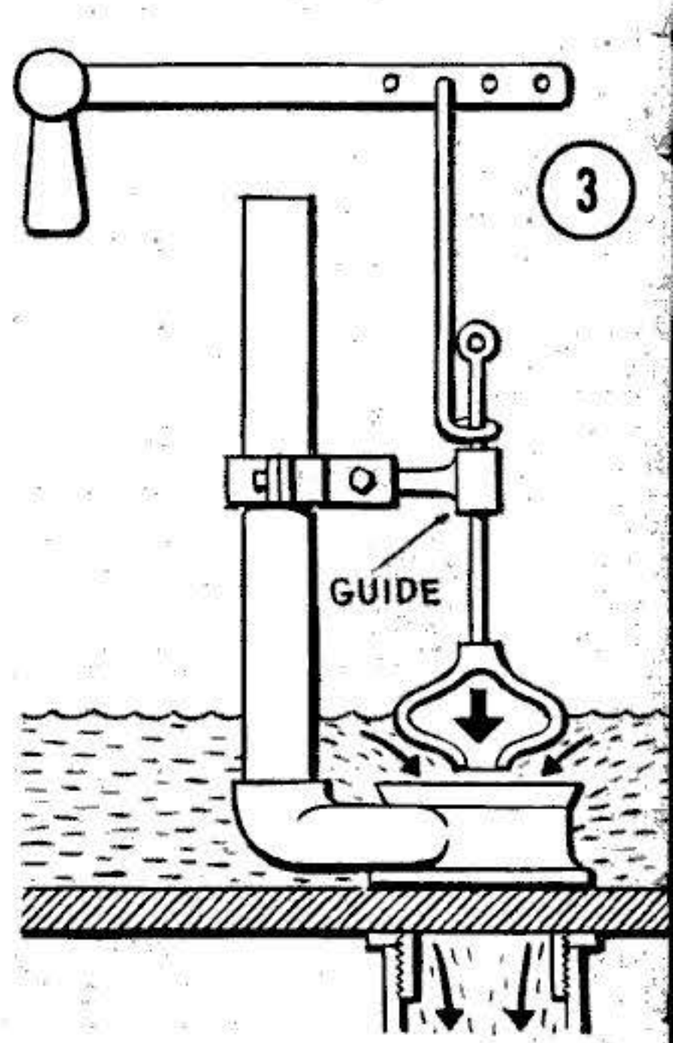
How the flush mechanism of a typical toilet tank works







Tripping the flush handle pulls the stopper off the valve, letting water rush out through the flush tube into the bowl as above (1). Air trapped in the hollow stopper floats it up as far as the guide allows (2), even after the handle is released and the tri arm is down, thanks to loose fit of the lift wires Flushing continues, but as the stopper sinks (3) it seats on the valve again, to permit refilling.

When you lift the lid of a toilet tank to make repairs, note first of all that you are dealing with *two separate mechanisms.* One automatically refills the tank with water. The other empties the water through the bowl below, doing the flushing job that the fixture is designed to do.

The mechanisms in your tank may vary somewhat in looks from your neighbor's. That's because new types have appeared on the market in recent years. This article will give you specific repair know-how for the older and more common type shown in the accompanying photos and drawings. Others will be discussed next month.

To start a repair job, shut off the water. For minor flush-valve adjustments, you can tie the float arm to a stick laid across the top of the tank. If there is a valve line under the tank, turn it clockwise. Lacking that, shut off the valve at the meter or in the cold-water line.

Flush-valve leakage. Usual indication of this is a low tank level, with the float down and the inlet valve letting in water continuously. The most common reason is that the stopper is tilted and has not seated right. A guide that lets the lift wire swing about too freely may drop the ball on the valve rim. The quick familiar cure is jiggling the flush handle.

Sometimes you can make a permanent cure by lowering the lift-wire guide a little—but not so much that it keeps the ball from floating free of the valve for thorough flushing. Loosen the clamp that holds the guide on the overflow tube, slide the guide down ¼″, and retighten it.

For about 50 cents you can replace the guide with one that has a longer neck. This reduces the swing of the stopper ball. When installing the new guide, adjust it to drop the ball exactly into the opening.

A badly rusted guide may be difficult to adjust or remove, and careless efforts may break off the overflow tube. Try applying penetrating solvent. As a last resort, heat gently with a torch.

If that also fails, cut the bolt that clamps the guide onto the overflow tube. This is fairly accessible, but if your hacksaw will not fit, use the blade only, with the teeth reversed to cut on the pull stroke. After the bolt is cut, insert a screwdriver blade between the two ears held by the bolt, and twist them apart.

When bending the refill tube up from the overflow tube so that the guide can be

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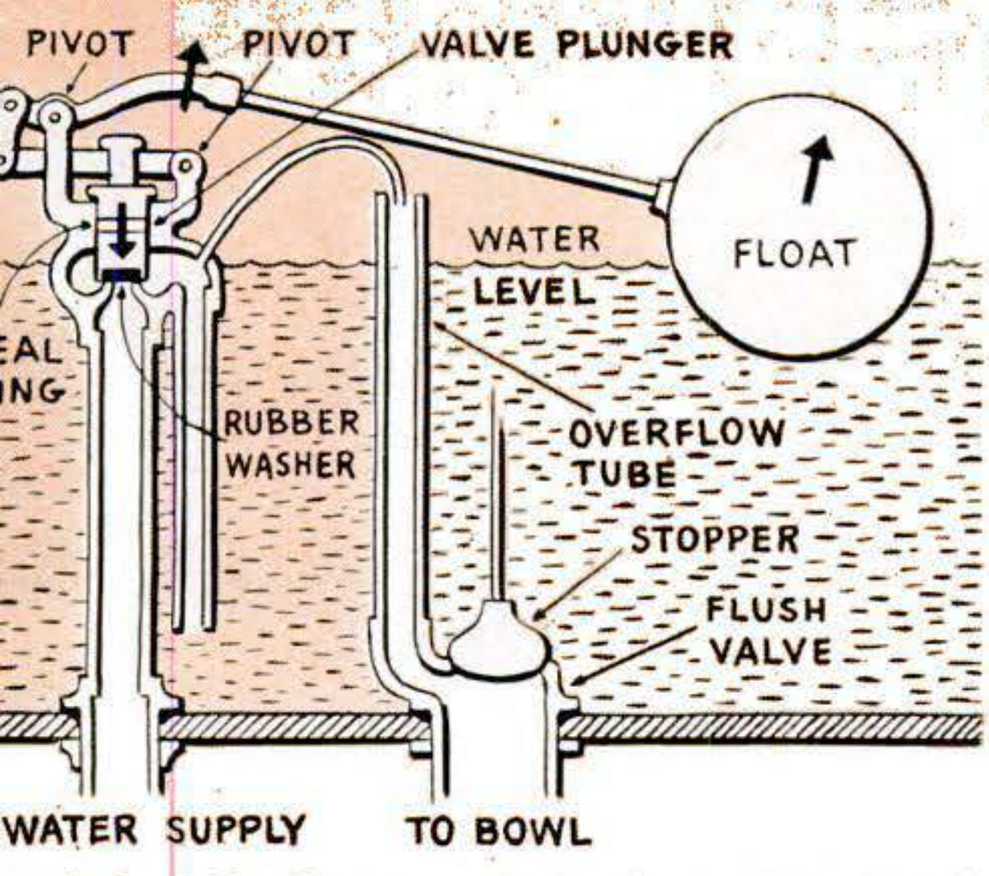
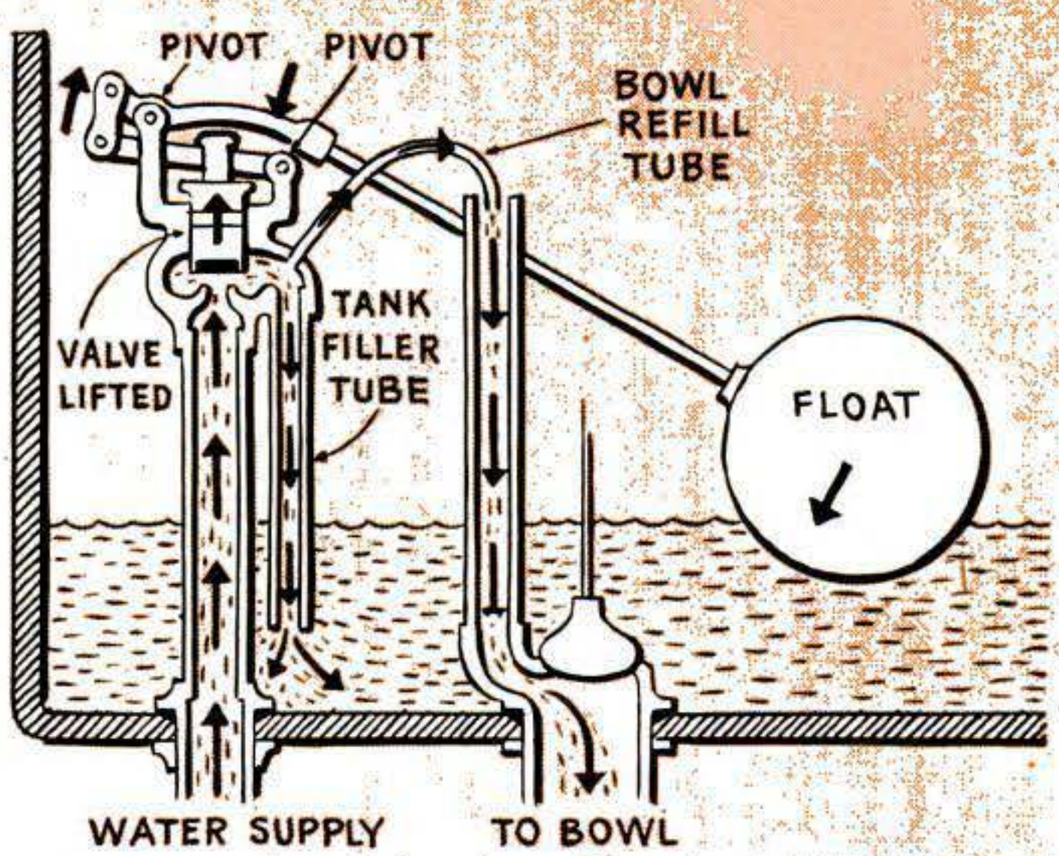
w the refill mechanism of a typical toilet tank works





tank is full, above, and the float rides in its ıost position. Its buoyancy, multiplied by the levers above the valve, holds the plunger firmly ı on its seat against water-line pressure. A hited seal ring in a groove in the plunger lubri- s it and keeps water from spraying upward when valve is open. The two lever pivots are remov- On flushing (right), the float falls with the water level, moving the levers as shown by the arrows to let the valve raise off its seat. Water runs through the filler pipe into the tank, and also through the refill tube, into the overflow tube and the bowl. This refills the bowl trap, which seals in sewer gases, to its proper level after flushing. When the float rises to the top again, it closes the inlet valve as shown at left.

slipped off, hold the refill tube with pliers where it threads into the ball cock. This will keep it from breaking as you bend the free end. If the tube is loose, tighten it snug with pliers.

If the old guide is correctly located, you may be able to solve the problem of a tilting stopper by getting a new one with a projection underneath. Prices start around 65 cents. Unscrew the old stopper from the lift wire and screw on the new one. Its projection, entering the valve opening first, will be centered by water flowing over the rim and so guide the stopper true. You can get this type with a snap-in projection, which can be removed should it prove to be too long or otherwise unusable, leaving you an ordinary stopper ball.

Jammed lift wires. A crudely bent upper lift wire or use of the wrong hole in the flush lever, pulling up at an awkward angle, are the common causes of jammed lift wires. Or a lower lift wire may have a bend so slight as to be hardly detectable and still bind at the guide. Considering the slight cost, both wires should be replaced when making tank repairs. Try to get yellow (brass) rather than red (copper) wires. They cost only a few cents more and last longer. Measure the lower wire before replacing it so you'll be sure to get the correct length. These wires come in two lengths.

Slip the two wires together and hold them in place in the tank, the lower wire resting on the tank ball. Lower the upper wire so there is slack between the two. Holding the upper wire with the left hand, use pliers to start a 90-degree bend pointing to the nearest hole in the trip lever where the wire will be vertical. Complete the 90-degree bend out of the tank and cut off the surplus, leaving about a ¾″ leg at the top. Now the wires can be put into the tank and the ¾″ end inserted in the trip lever and bent down. The bend should form an oval to prevent binding.

If the trip lever is more than ¼″ horizontally from the vertically held lift wire, bend the lever in a horizontal plane toward the back or front of the tank.

At no time should the lift wires support the weight of the trip lever, for this may result in occasional binding. If the trip lever falls below the guide when no lift wire is attached to it, bend it higher. If the stop at the handle end is so worn

Continued

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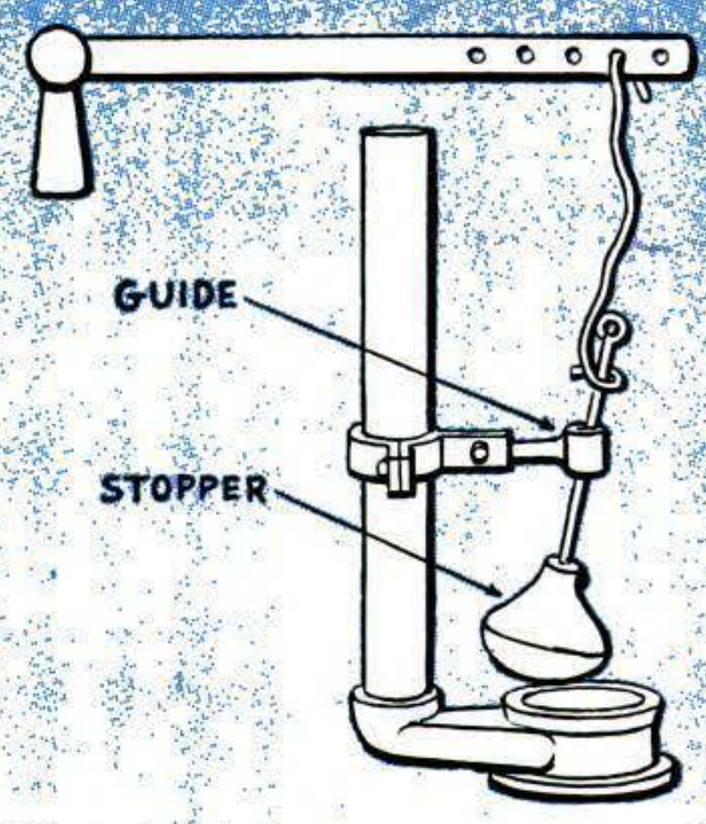
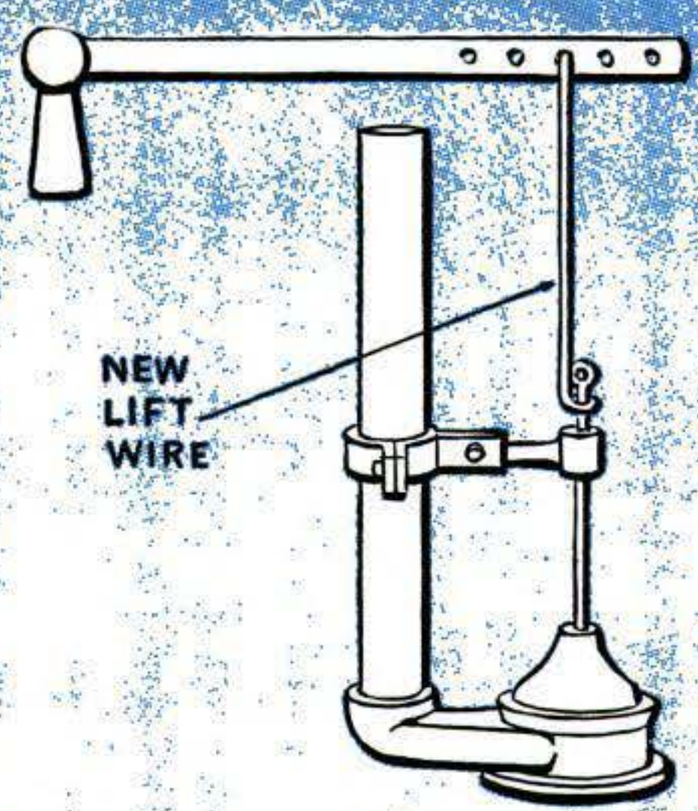
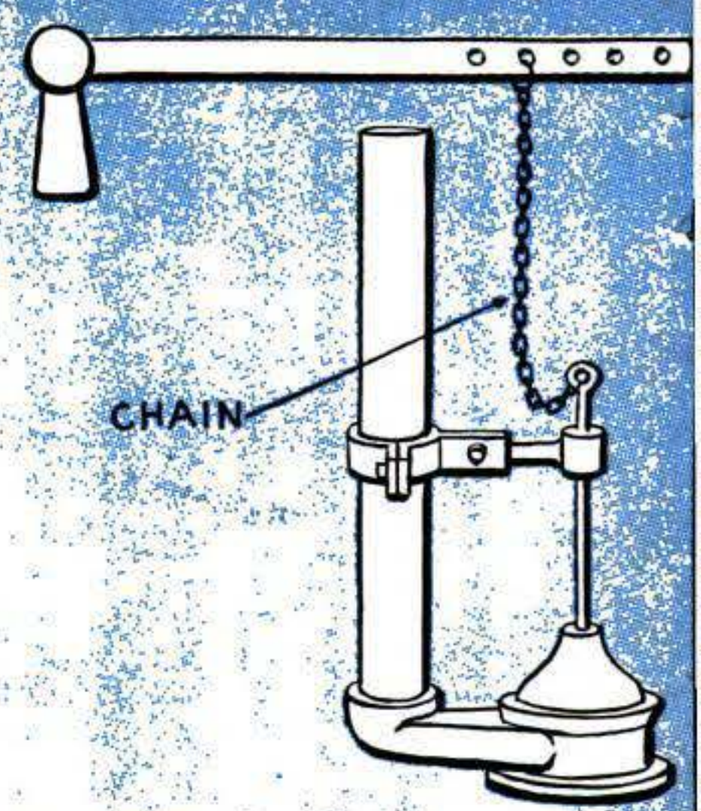
Why flush valves leak and what you can do about them

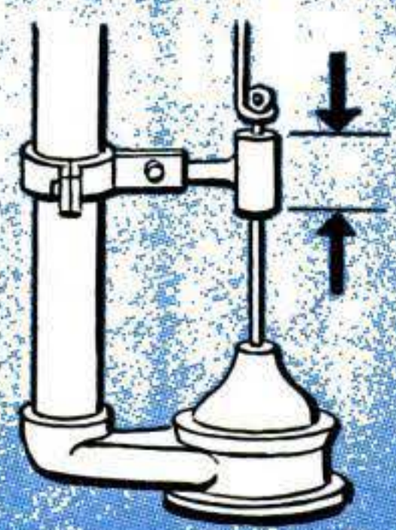






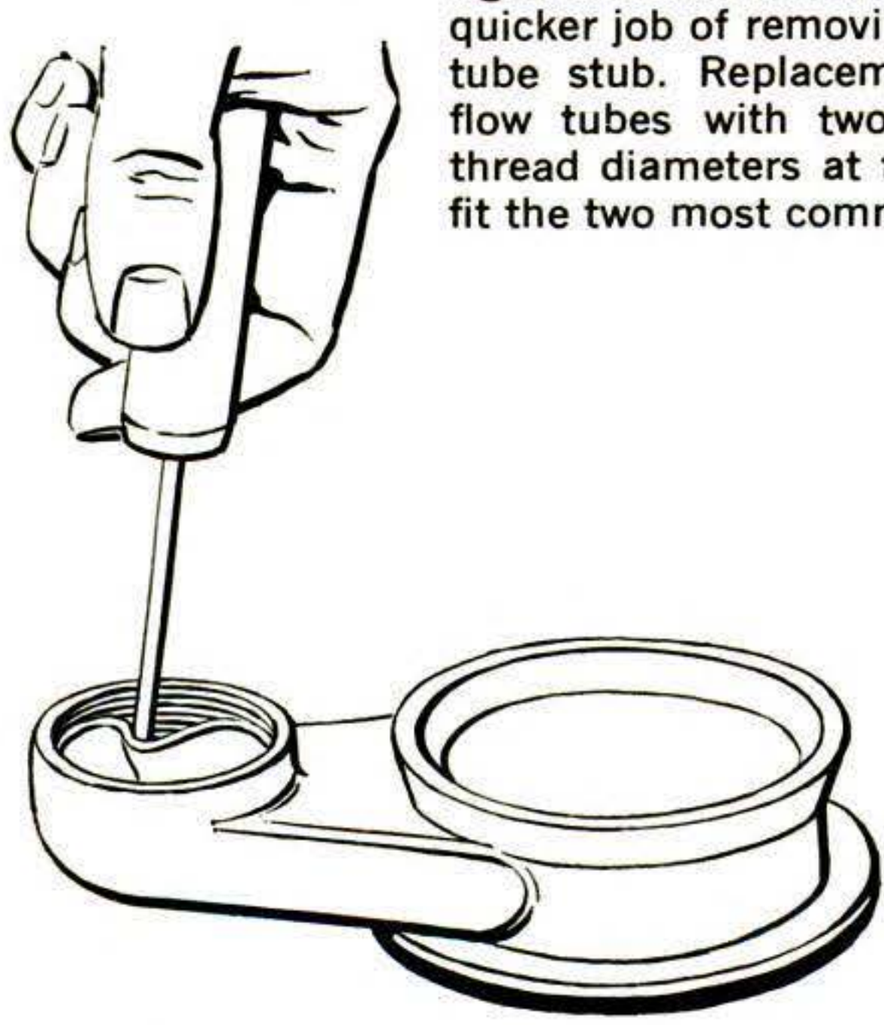
Misshapen lift wire may "hang up" stopper (left). Shape new wire neatly. Hook it into hole most nearly above guide (center), or replace with nonrust chain (right). Chain should be slack as shown.

If lower lift wire can swing excessively, stopper may perch on valve rim and fail to close. One cure is a guide with a longer hole to restrict swinging (center). Another is a stopper with a projection beneath. Outrushing water centers ball.



Removing a broken stub of tubing

When an overflow tube or a bowl-refill tube breaks, it is usually where it threads into the flush-valve casting or the ball cock. To remove the threaded ring left in, push an ice pick or awl point between the stub and socket. Tap lightly with a hammer to push the ring inward, until by prying and tapping the ring is collapsed and separated from the socket, when it can be lifted out. If a screw extractor of the right size is at hand, it will do a quicker job of removing a refill-tube stub. Replacement overflow tubes with two different thread diameters at their ends fit the two most common sizes.



that the lever arm sinks below the guide, replace the arm.

The lower wire screws into the stopper ball, completing the repair. But an even easier and better fix for tangled lift wires will cost you only about 25 cents. Throw away the upper wire and buy a light stainless-steel or brass chain (some come with a new lower wire). Hook the chain between the flush lever and the top of the lower wire. The chain should be a little slack when the valve is closed.

An off-center stopper will also perch on the valve rim and leak. The guide may be set too near or too far from the overflow tube. If it has a length adjustment, loosen the setscrew and reset it right.

If the ball is off center because it is too far toward the front or back of the tank, loosen the screw that clamps the guide to the overflow tube. Then swing the guide slightly on the tube to center the ball, and retighten it.

Stopper and valve defects. Stopper balls last a long time, but inspect the one in the tank when making other repairs. If it is

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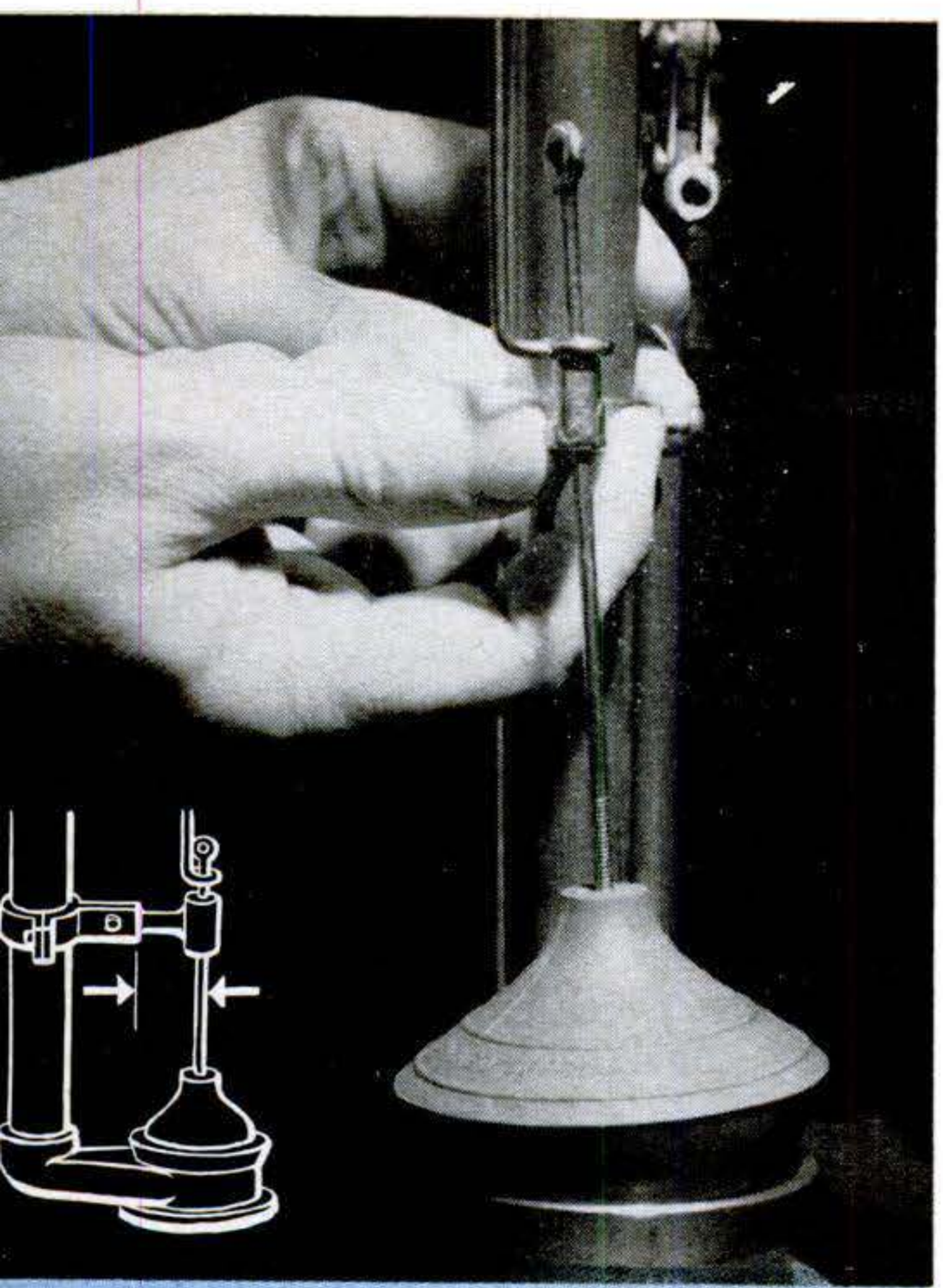

guide incorrectly set on overflow tube may drop
pper off center. Readjust guide to center stopper.
stopper is toward front or back, loosen the guide
d swing it into alignment.

cracked, warped out of round, or has scum on it, get a replacement. One of soft rubber will usually adapt itself best to an old valve seat.

Even with a good stopper, a roughened valve seat will cause an almost invisible leak. This means a constant trickle into the bowl. To check for such a leak, pour a little laundry bluing into the water in the tank (after the last flushing, when no water is running). Color in the bowl indicates the flush valve is leaking.

It may be possible to smooth a rough valve seat by hand polishing with fine steel wool or 500-grit wet-or-dry abrasive paper. But if leakage continues, the flush valve should be replaced, as will be explained in a later article.

If flushing stops as soon as the flush handle is released, making it necessary to hold the handle for complete flushing, the lift-wire guide is probably too low and doesn't let the stopper rise enough to float free of the suction of the outrushing water, which therefore yanks the stopper back. Loosen the guide and set it ½″ higher on the tube.

A wobbly flush handle is easily tightened with a wrench on the hex nut inside the tank. But this has a left-hand thread that must be tightened counterclockwise (as seen from *inside* the tank). With the wrench sticking up, swing it to your right. Should you want to replace the trip lever, remove the old one (swinging the wrench to the left) and note the size and shape of the hole in the tank. Before buying the new lever, make sure it fits the hole.

Refill-valve troubles. An overfull tank spilling into the overflow pipe indicates the inlet valve isn't closing. If the float has snagged on a lift wire or chain, you needn't look further.

A leaky float can lack enough buoyancy to close the valve firmly, even though it doesn't sink. Shut off the water supply. Then unscrew the float and shake it. If there is water inside, get a new float.

A brimming tank also may be due to a high float arm that fails to close the valve even when the float rides high. Examine the ball cock to see if it has a water-level adjustment. If not, tighten the float arm in its ball-cock socket with pliers (a loose arm may twist and so alter the water level).

Then grasp the arm in both hands and bend it in the middle to lower the float about 1″. The normal water level should be about ¾″ below the rim of the overflow tube. If a shorter flush will do, you can save water by bending the arm even lower, but never so far that the water shuts off before the bowl trap has been refilled (as shown by the level in the bowl).

Should you replace a float arm, make sure the new one has sufficient thread to allow cutting it shorter if necessary. Leave it long enough to keep the float clear of the lift wires.

A defective inlet valve will admit water after the float has closed it. Shut off the water supply, and flush the bowl to empty the tank. Then unscrew the lever pivots (counterclockwise), pull them out, and lift the levers straight up, taking note of the way they fit for replacement later. Slide the lower lever out of the slotted top of the plunger, and lift this out.

Usually the rubber disk or gasket at the bottom of the plunger is defective. Some may be pried out. Others are held by a screw, like a faucet washer. Take the entire plunger with you when buying a new

Continued

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gasket. Replace the packing ring, too. Repair kits are sometimes available for this.

A plunger that is heavily encrusted can be cleaned by soaking it in hydrochloric acid. (Wear goggles, and exercise care.) This dissolves all calcium deposits and is harmless to brass. Rinse the plunger well before fitting a new ring and gasket.

Hydrochloric acid will clean encrusted ball-cock levers and bolts, too, restoring free action. Buy just enough acid for the job at a drugstore, discarding any left over so it won't endanger children or pets.

Before replacing the plunger, examine the valve seat with a flashlight. Some minerals in water will corrode seats. As with faucets, a slow leak may cut a groove in a brass seat, requiring replacement of the entire ball cock.

When you buy a replacement, ask for a code-type anti-siphon ball cock. An anti-siphon ball cock has a vacuum-breaking device above the water level to prevent siphoning water from the tank into the water line. Without this, a clogged bowl and a leaky flush valve could cause seepage between the bowl contents and drinking water.

Measure the inside height of the tank to get a ball cock that will just fit. This will keep the vacuum breaker above the water and provide more clearance between the float arm and lift wires.

Installing an inlet valve. Shut off the water, flush the tank, and soak up the remaining water with a rag or sponge to avoid drenching the floor. Unscrew the float arm from the lever assembly and set it aside. Then unscrew the slip-joint nut connecting the water-supply line.

Next, remove the thin hex nut snugged up against the tank bottom, using an adjustable wrench, a pipe wrench, or lock pliers. This nut is usually not overtight, but only snug. Avoid using a wrench inside the tank except as a last resort; if you do, pad it thickly and avoid heavy pressure. Some tanks could be broken by a wrench pushing outwards from inside.

Assemble the float arm and float before putting the new ball cock in place. This will enable you to position it for free float action. Hold the ball cock firm while tightening the water-supply nut.

If the supply tubing is connected with a slip nut and rubber gasket, scrape the tubing clean where the gasket fits. Then replace the gasket. You can do this before installing the new ball cock, for it can be set down over the tubing.

The bowl-refill tube, which screws into the inlet-valve body, must be bent over until its open end enters the overflow tube. To avoid breaking it where it threads into the valve, hold the ball-cock end with pliers while bending the tube.

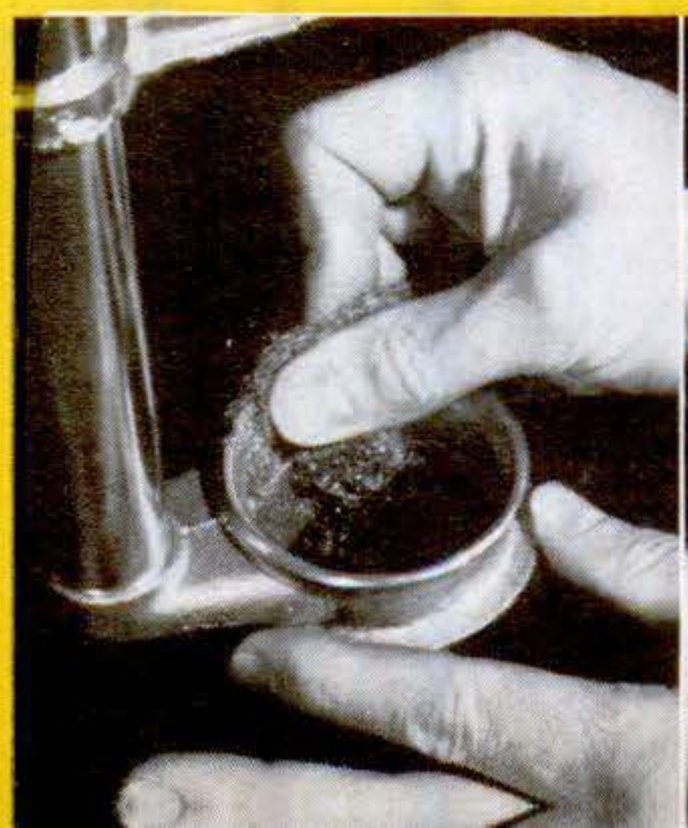
The sneakiest leak of all. That's what happens if you bend the refill tube down below the full-tank level. It will then siphon water constantly up the tank filler pipe and into the overflow tube. Whenever the level drops enough to stop siphoning, the float will open the inlet valve and start it all over again. This kind of leak is almost silent, but it wastes water, can cause freeze-ups in the outside sewer line, and creates septic-tank troubles.

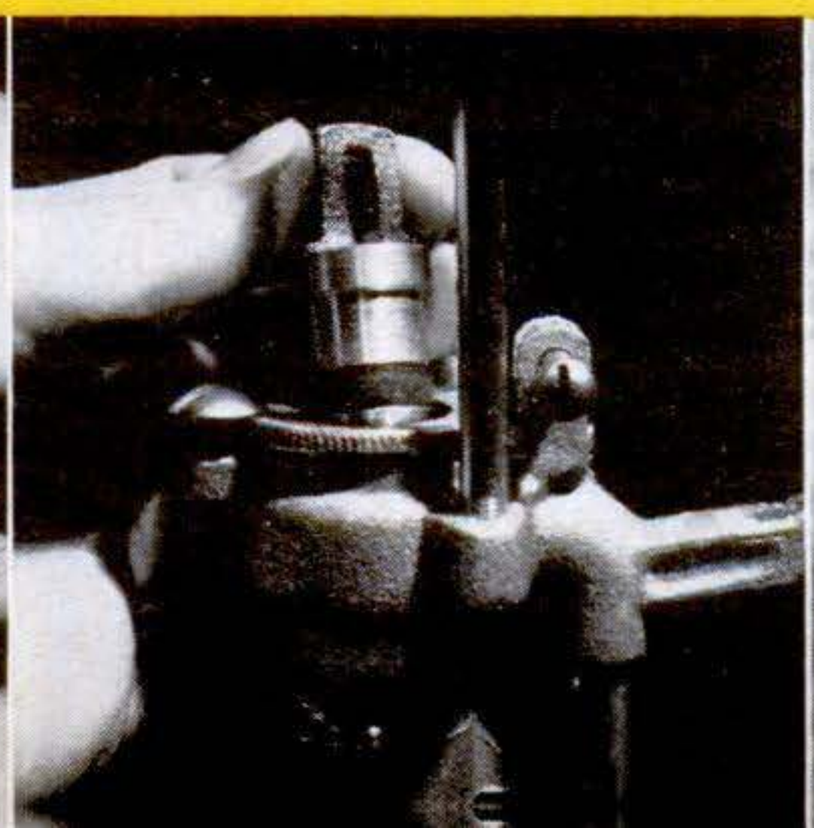
To check for this and other slow leaks, put coloring matter in the tank water as already explained. Mark the water level on the wall inside the tank with pencil or crayon, and check it after 10 minutes to see if there is a slow, silent leak in the ball cock.

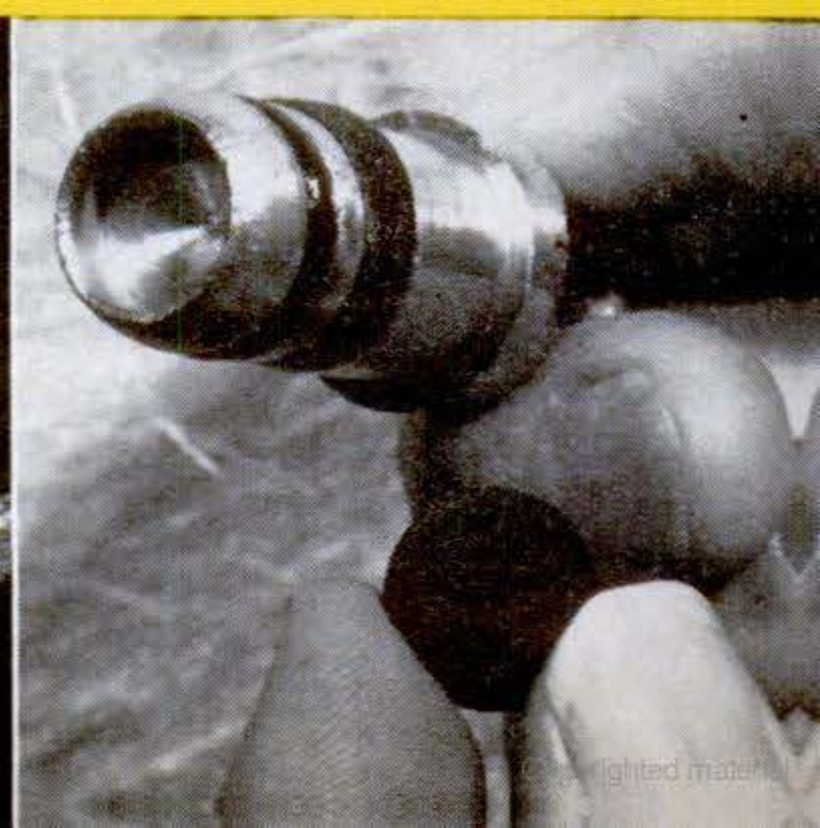
Slow filling of the tank may be due to low water pressure. If not, look for rust deposits in the inlet valve. If this has a strainer, remove and clean it. Hold a cup or can upside down over the ball cock while letting the water run a few seconds. This will clear out any clogging matter.

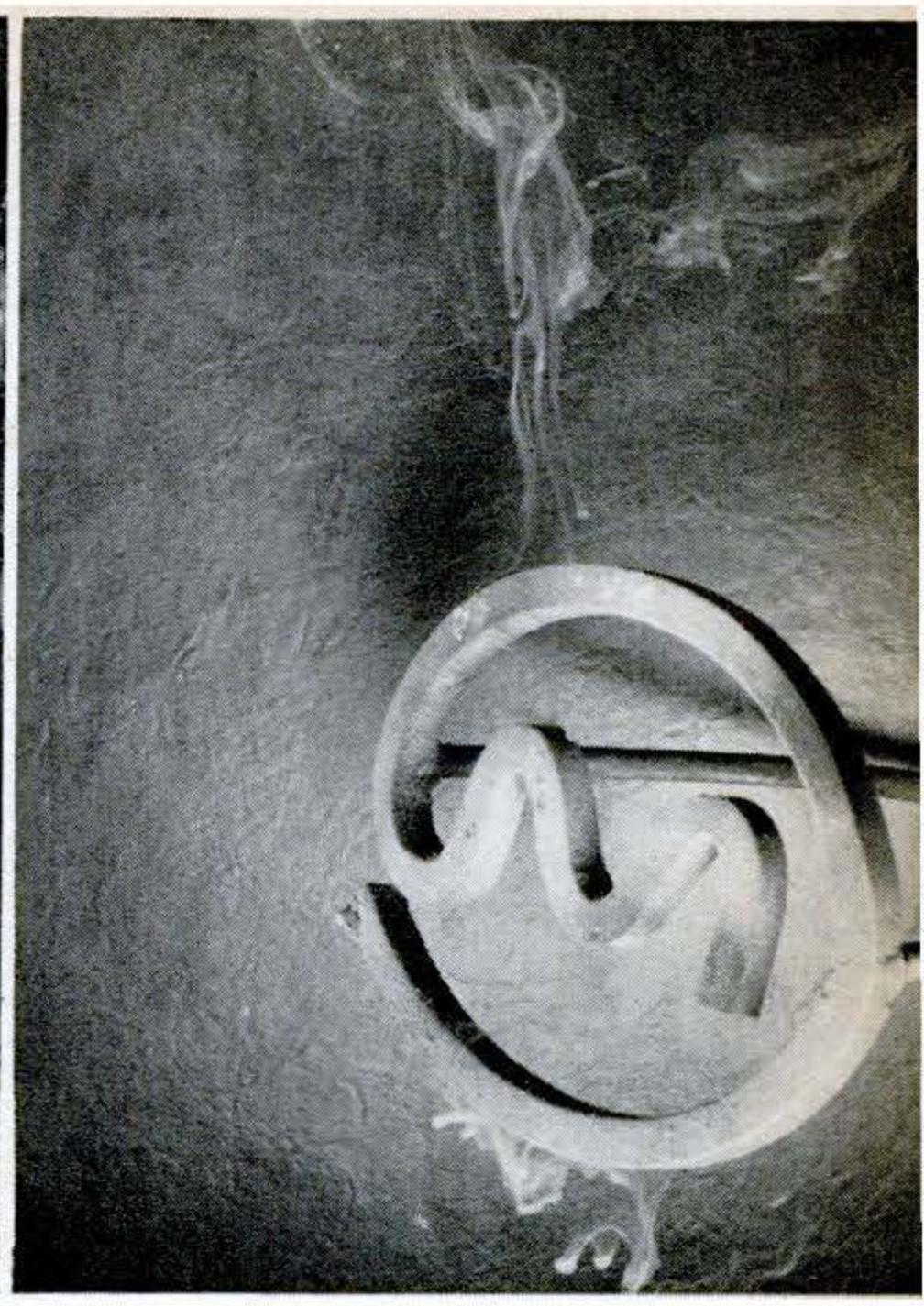
That's it—until next month.

Scour flush-valve seat with fine steel wool to remove deposits that may cause leaking. The inlet-valve plunger lifts out, center. A defective gasket in bottom of plunger (right) may cause valve failure.









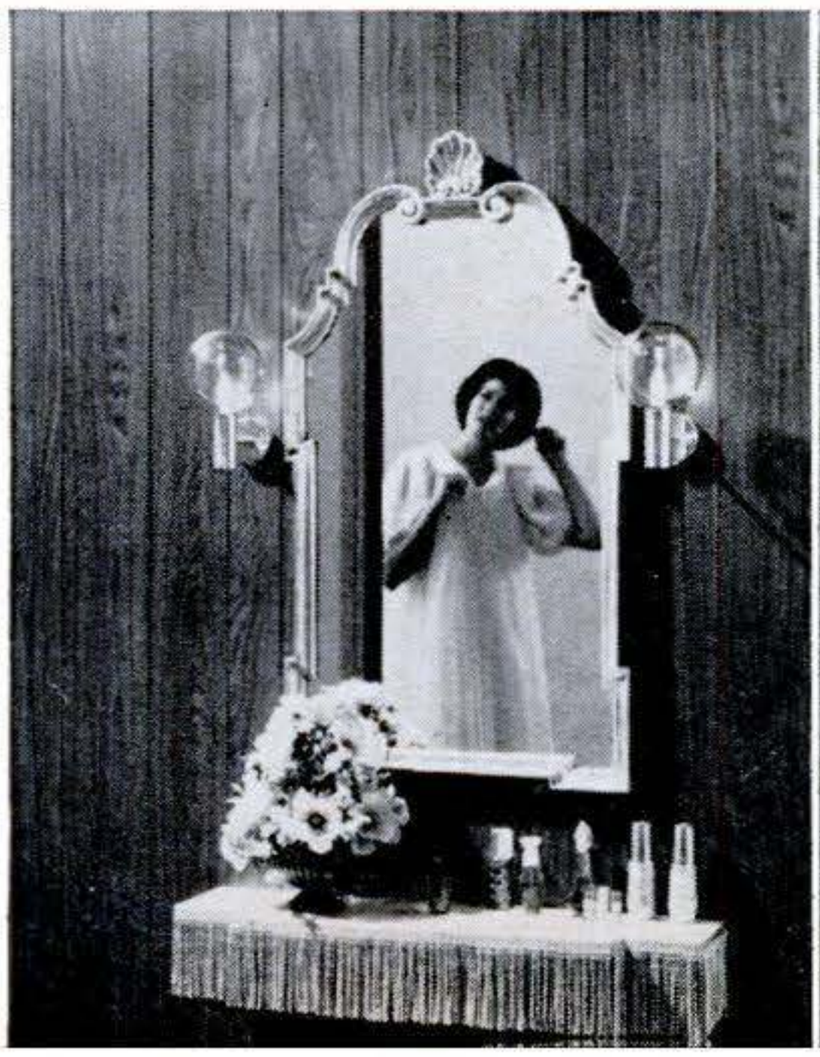
Panel with leather? You get the feel and look of cowhide in this new Marlite paneling. The plastic-finished hardboard can be applied over any solid surface with wallboard adhesive. The surface is resistant to heat, moisture, and wear. Damp-wiping cleans it. Panels come in brown, tan, green, and white. Yup, that's a real branding iron at right, to suggest the real leather look.

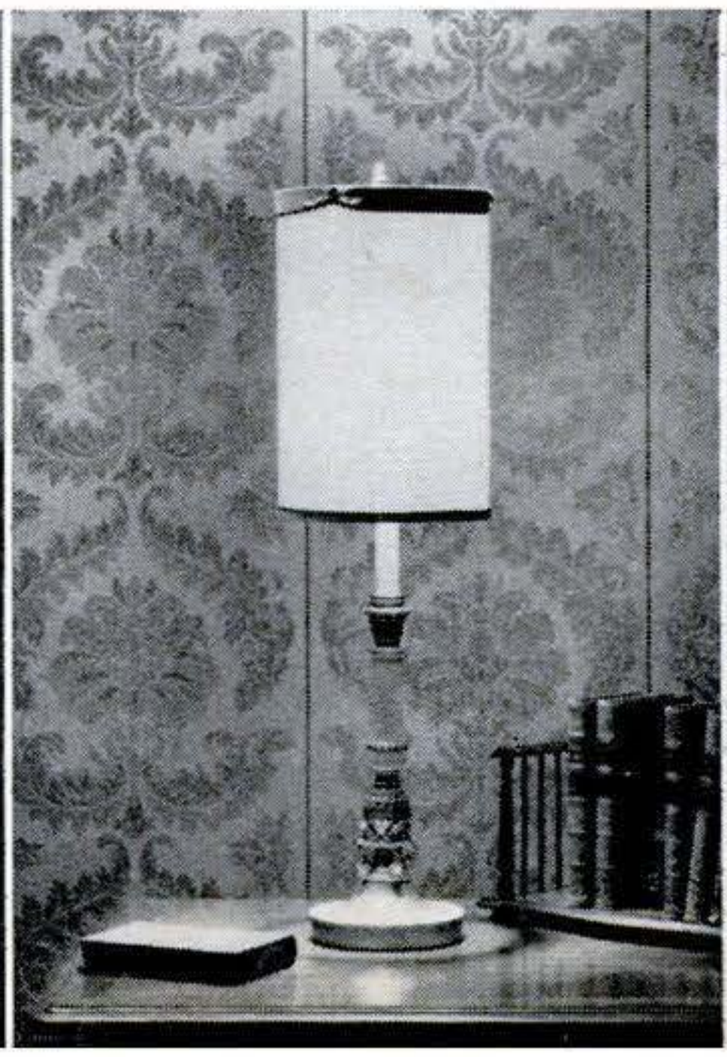
New Ideas in Wall Panels

Grain and color of real hardwood are reproduced in Muralwood paneling made by Weyerhaeuser. The paneling is grooved to look like random-width boards, with a groove falling every 16″ to match stud or furring-strip spacing for inconspicuous nailing. Panels come in teak, rosewood, walnut, butternut, cherry, birch, with stains to color-match moldings and trim.

The look and feel of tapestry is what you get on walls covered with Marlite's textured paneling. It has the raised surface design of a high-quality woven fabric. The paneling comes in tongue-and-grooved 16″-by-8′ planks. The plastic finish is tough and can be damp-wiped clean. Available colors are red, green, and gold. Color-matched moldings are also supplied.

At home indoors or out is this redwood paneling for siding, wall surfacing, or fencing. Sizes range from 1″ by 4″ up to 1″ by 12″. It's Georgia-Pacific's Crescent-Sawn with a decorative, circular-sawn texture. Light or heavy texture may be specified and, for fencing, texture on both sides. Standard length of the boards is 20′.





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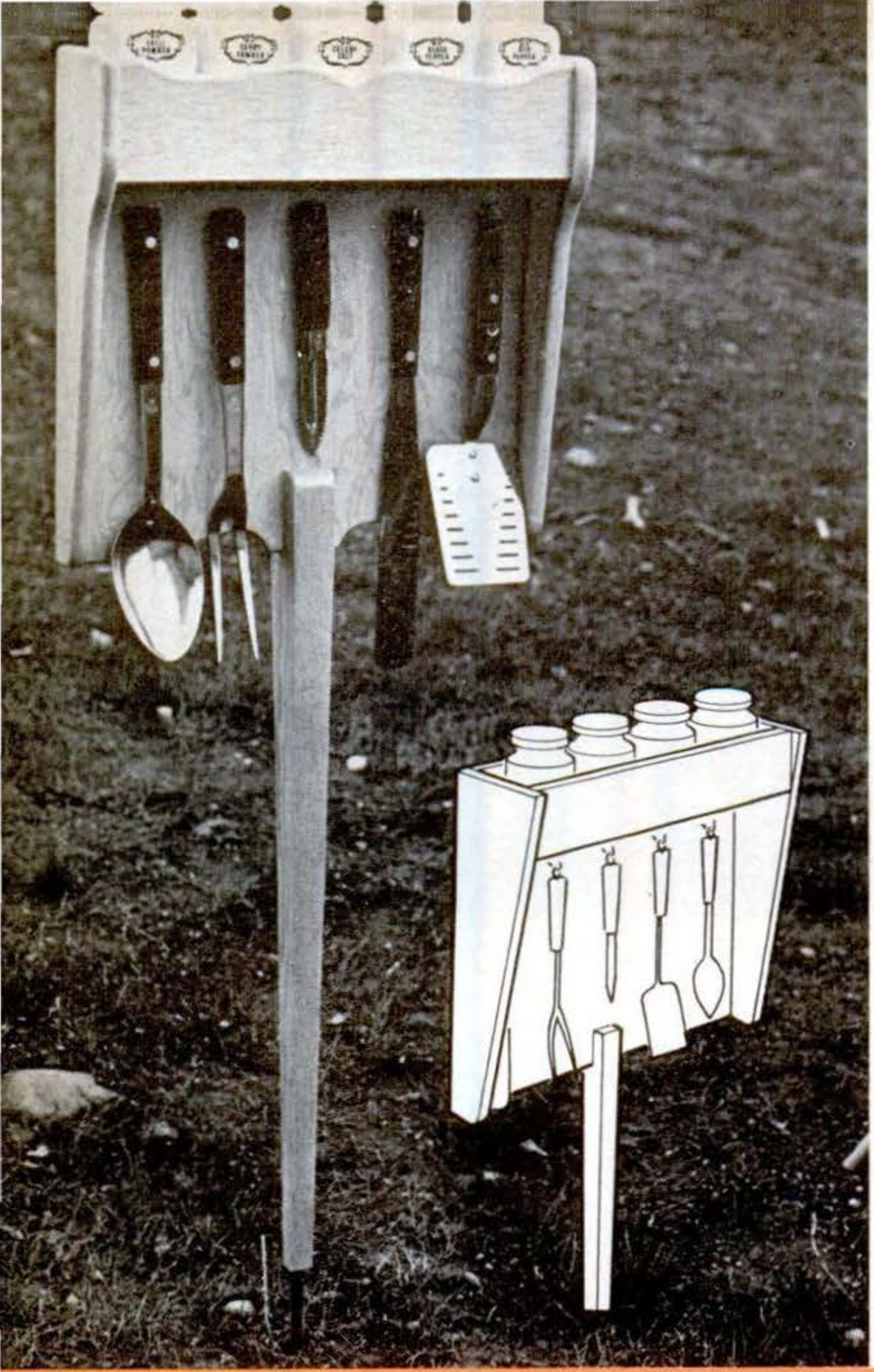


DESIGNED BY DAL FABBRO

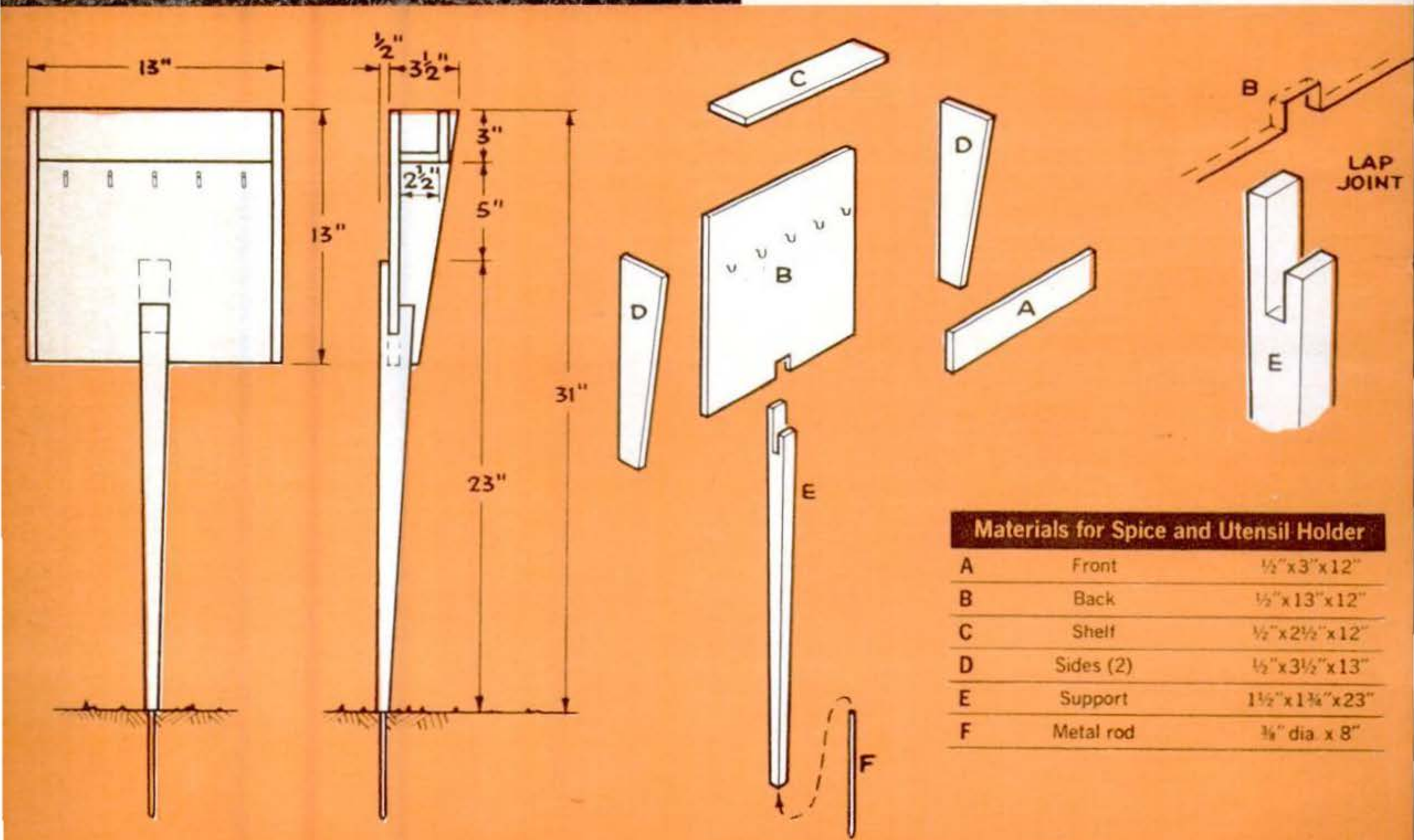
Two Lawn

Take it from the internationally known furniture designer who created them: These practical and imaginative lawn accessories will add charm and luxury to your outdoor parties and barbecues.

The projects are two of 110 original designs by Mario Dal Fabbro appearing in drawings and diagrams in his latest book, *How to Make Wood Furnishings for Your Home*. Published by McGraw-Hill (copyright 1965), the book sells for $5.95.

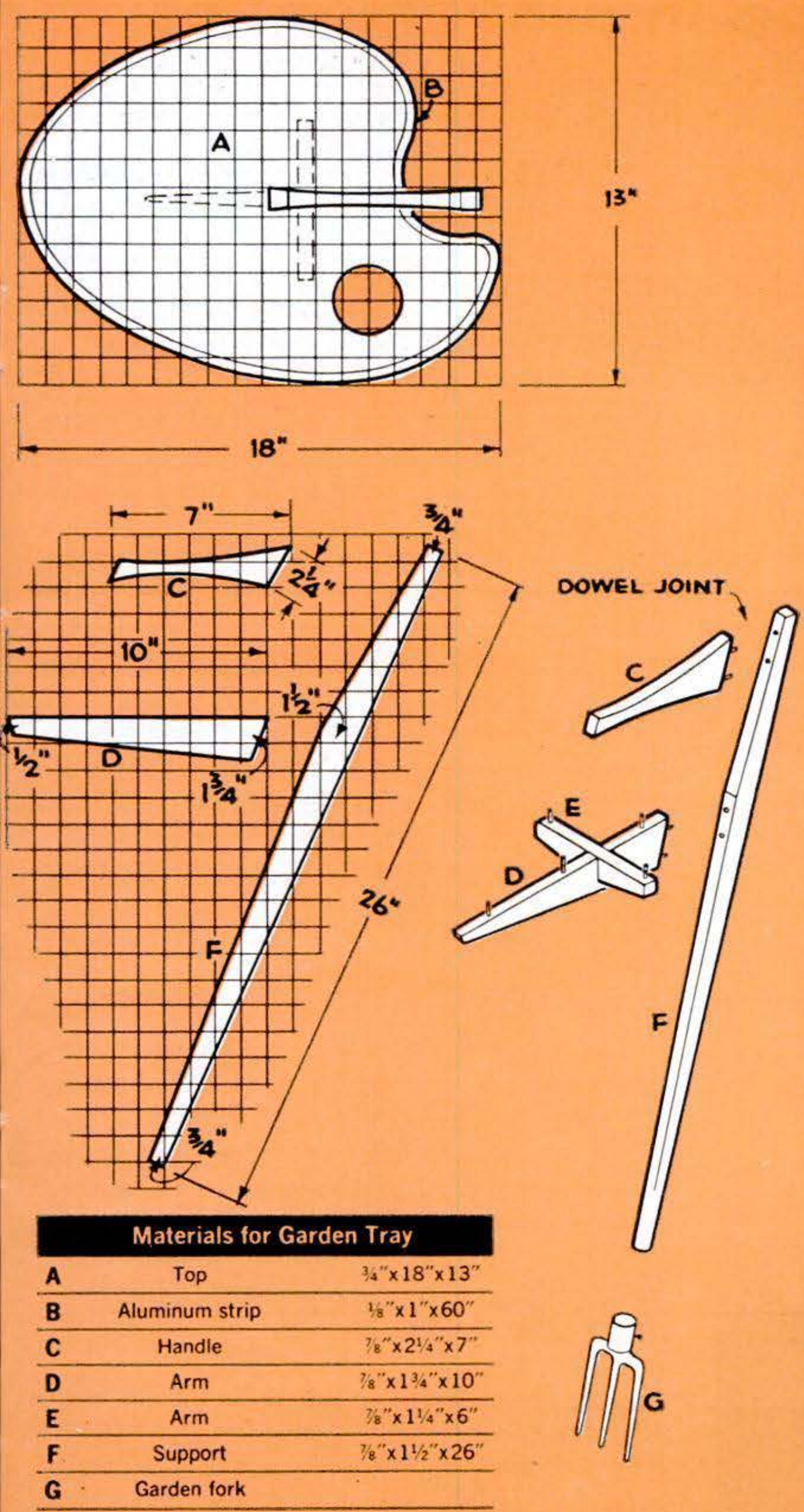
A craftsman commissioned by POPULAR SCIENCE built the garden tray and utensil holder as shown in the photos. Though based on Dal Fabbro's designs, they include a couple of minor changes: Curves were added to the spice rack for an Early American flavor. And 1/16″ aluminum stripping was used around the garden tray since ⅛″ stock proved hard to find.

Assemble sides, shelf, front, and back with dowels and glue, and notch the back at the bottom edge to fit notch on support. Cut out the support, tapering it as shown; then drill the bottom, insert a sharpened metal rod that has been drilled through the top, and secure with a wood screw. Apply finish.



Materials for Spice and Utensil Holder		
A	Front	½"x3"x12"
B	Back	½"x13"x12"
C	Shelf	½"x2½"x12"
D	Sides (2)	½"x3½"x13"
E	Support	1½"x1¾"x23"
F	Metal rod	⅜" dia. x 8"

Aids You Can Build



Materials for Garden Tray		
A	Top	¾"x18"x13"
B	Aluminum strip	⅛"x1"x60"
C	Handle	⅞"x2¼"x7"
D	Arm	⅞"x1¾"x10"
E	Arm	⅞"x1¼"x6"
F	Support	⅞"x1½"x26"
G	Garden fork	

Cut out tray and nail on the aluminum stripping. Arm that holds tray is assembled from two pieces notched and glued together, then attached to support with dowels and glue. Dowels and glue also secure handle to support and tray to arm. Attach garden fork to lower end of support. Apply finish.

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POWER-TOOL WORKBENCH

your own home-improvement center

When it was introduced in 1959, the POPULAR SCIENCE Split-Level Workbench was instantly popular; it was the first workbench designed expressly for hand power tools. Now, here's "Son of Split Level"—as advanced as its forebear was eight years ago. Only now it's a whole shop system, with all the advantages of the original, plus:

- *No cords.* The individual cords from all the power tools have been swapped for a single, interchangeable one. A quick-disconnect fitting—adaptable to almost any electric tool—lets you easily change this cord from one tool to another with one hand. It winds up when you're through. And it's always suspended above the work—there's no tangle.

Split levels give you a choice of sit-down or stand-up working. Helper bench flips to make three more work heights, doubles as a work stool (above).

- *A helper bench that works.* This bench assists with the holding, squaring, gluing, leveling, bracing, propping, turning, and moving that are part of every shop job. It has three heights and two kinds of work surfaces, and a wheeled dolly to put beneath it.
- *Locking cabinets.* All your tools—hand as well as power—can be locked up, away from children or borrowers.

Of course, the classic features of the original Split Level remain. They include a 4′-long stand-up bench; a smaller sit-down work table; a storage shelf for bulky items; and a cabinet for all your power tools. There's even a rack for drills, router bits, saw blades, and other accessories.

The lower work level is the fold-down door on the power-tool cabinet. This gave the original Split Level its name. Supported by a swinging leg and a piano hinge, the opened door is just right for sit-down jobs. There's a handy electric outlet nearby.

The pull-out bench at its lowest level—16″—supports a four-by-eight sheet. The open grid holds cut-off pieces, and there's no harm to saw blades in accidentally clipping one of the bench parts—the screws are safely recessed.

Gluing or assembly jobs are supported by the open bench, rather than by the gluing clamps. Clamps fit neatly between the grids and below the work surface. You have a choice of three heights; just turn the box-like helper on any side to get the best height.

The lowest level is the dolly—it's a scant 4″ above the floor. Combined with the helper bench, it becomes a variable-height cart, tool caddy, paint turntable, or rolling workbench. By itself, the dolly helps move furniture and other heavy things. You can even use it in the garage as a creeper.

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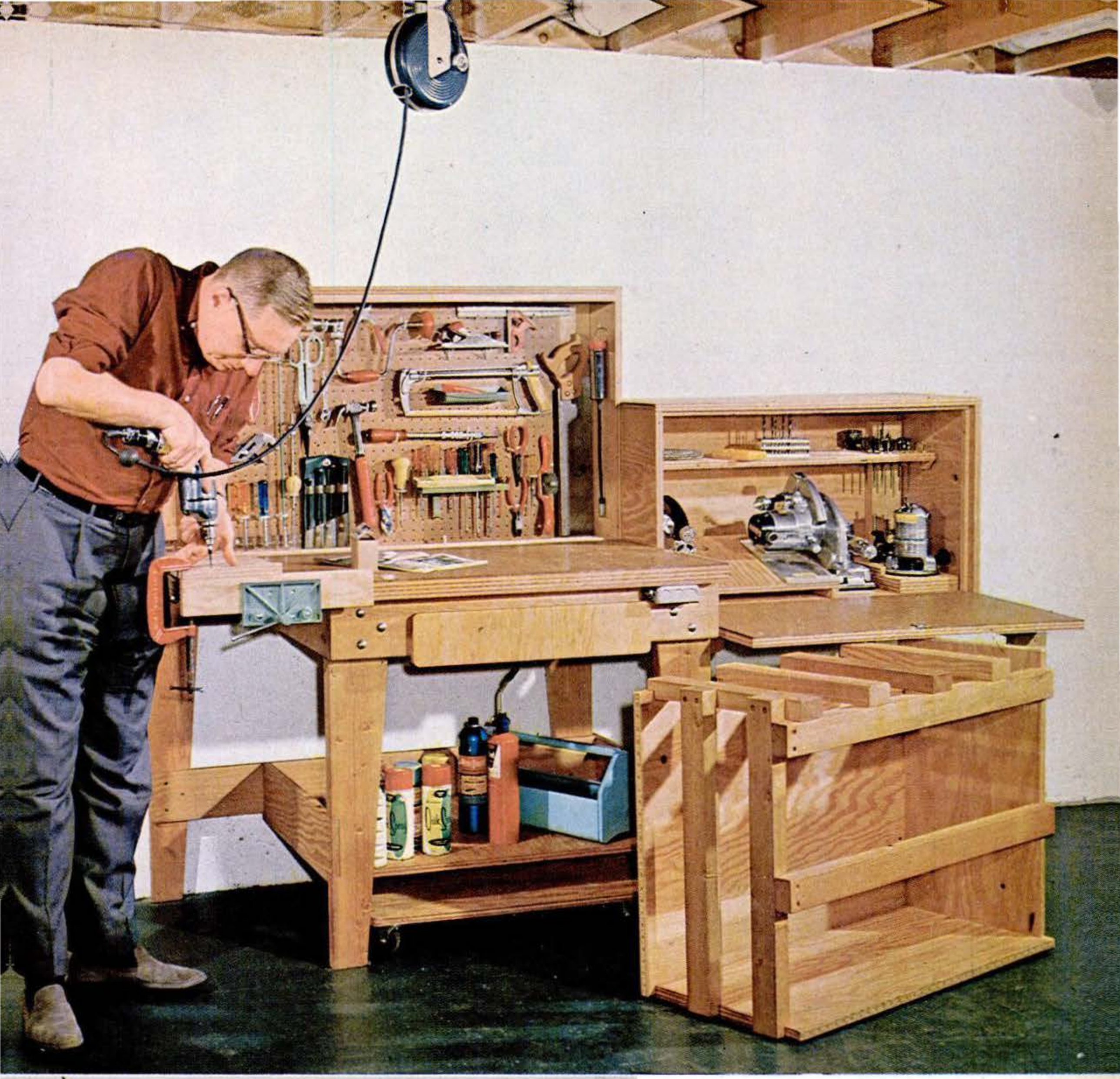

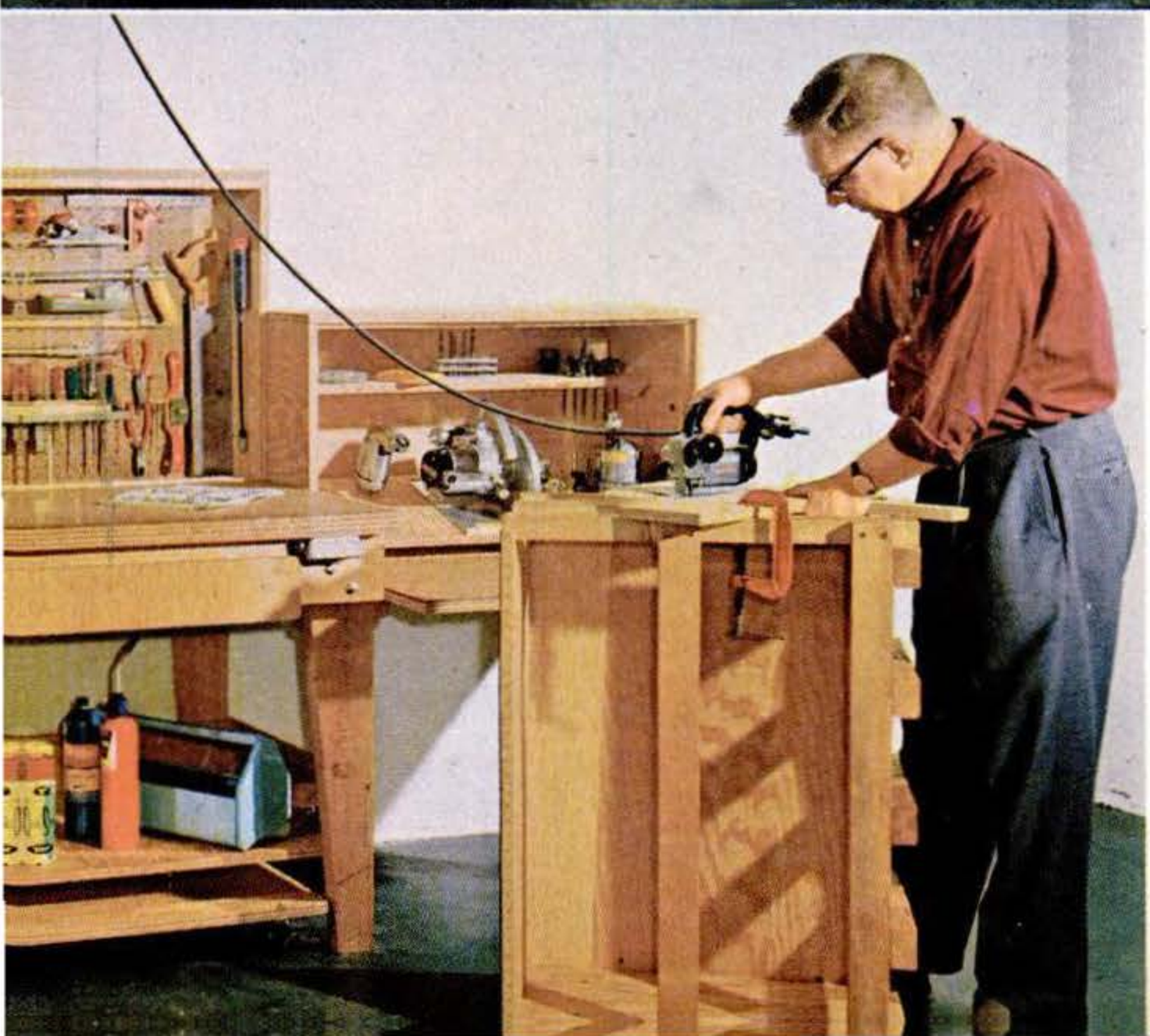

Five work levels, an overhead cord system, and locked cabinets are some features of this workbench. To build it, follow the PS lie-flat blueprint

By ERNEST E. HICKMAN
PHOTOS BY BILL MORRIS

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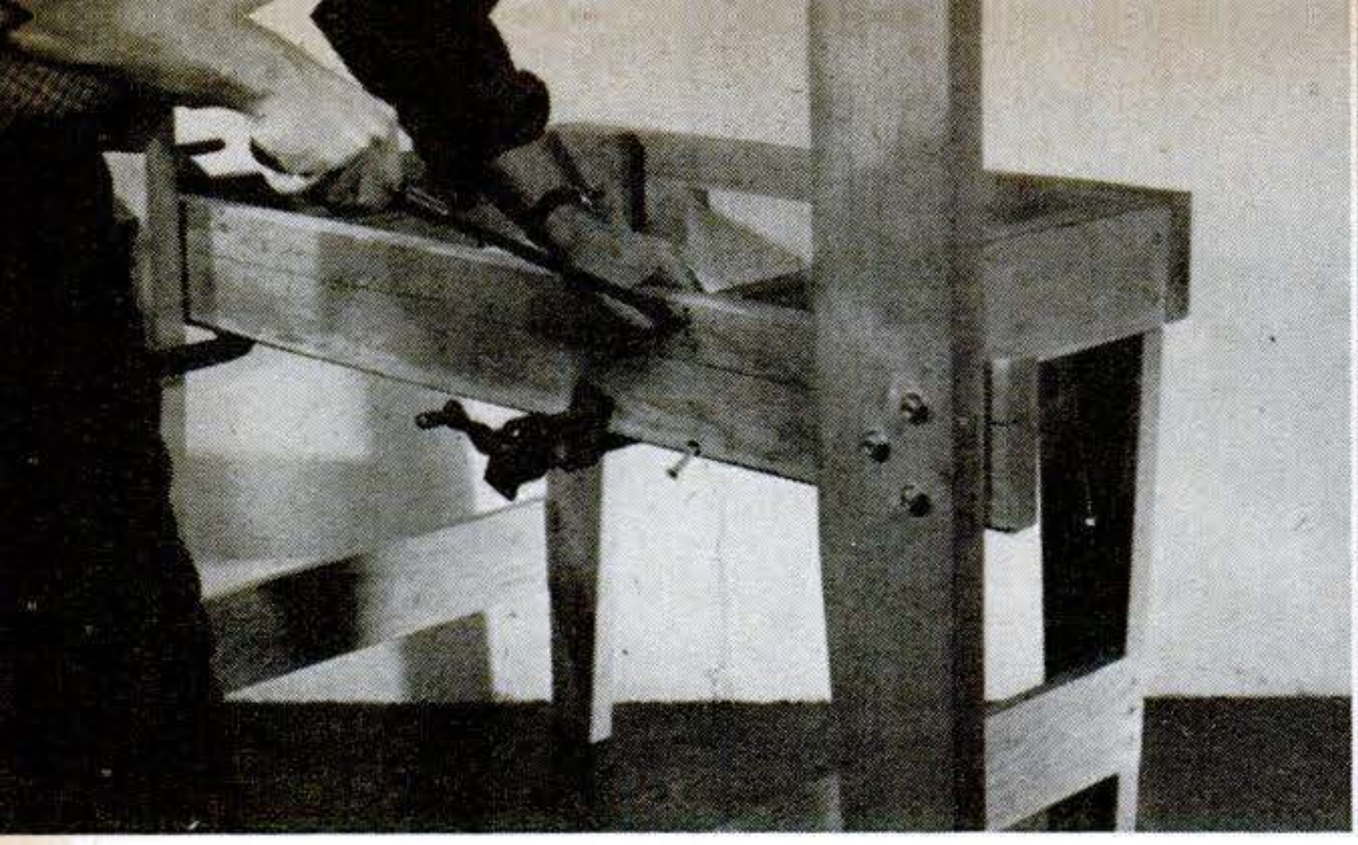


Assemble the frame from two-by-sixes cut as shown in the blueprint. First build the two sides, attach rear rail and left rear leg, then add front rail.

Turn the bench upside down after adding the bench top and tool cabinet. This makes it easy to install drawer runners, lower rear rail, and bottom shelf.

The shop is built mostly from plywood —three sheets of ¾″ plywood. Even the bench top, traditionally 2″ planks, is made of two sheets of plywood glued and screwed together. Tools are stored on Delrin plastic fixtures—they're strong, and won't nick cutting edges or fall off the perforated hardboard.

Build the helper bench first, and the shop starts working for you before it's completed. Clamp the plywood parts while joining them with glue and 1½″ #8 screws. Use a combination countersink-counterbore pilot drill to make the screw holes, and angle the holes sharply when driving screws into end grain. If the counterbores come close to plywood edges, reinforce them by gluing wood plugs in the holes after the screws are in.

To protect the plywood edges of the helper bench, fasten cut-down yardsticks to the edges with contact cement. They'll be handy for rough measurements.

The open framework can be either two-by-three lumber or two-by-six stock ripped in half. Put the two-by-threes together with 2″ #12 screws, counterbored ⅝″ below the surface of the grids. As you rabbet the ends of the framework, be sure to have an exact inch above the plywood edge.

Taper the bench legs before you cut them to length. That gives you more room to hold a straightedge guide for your saw. When notching the front and right rear legs, check the actual stock dimensions.

Assembling the bench. Assemble the two sides first—the right front leg, right rear leg, and upper and lower right rails, then the left front leg and left upper and lower rails. Bolt the rear rail to the left rear leg; this assembly, clamped to the right side assembly, makes a unit that stands by itself, and to which the left side subassembly and the front rail can be added.

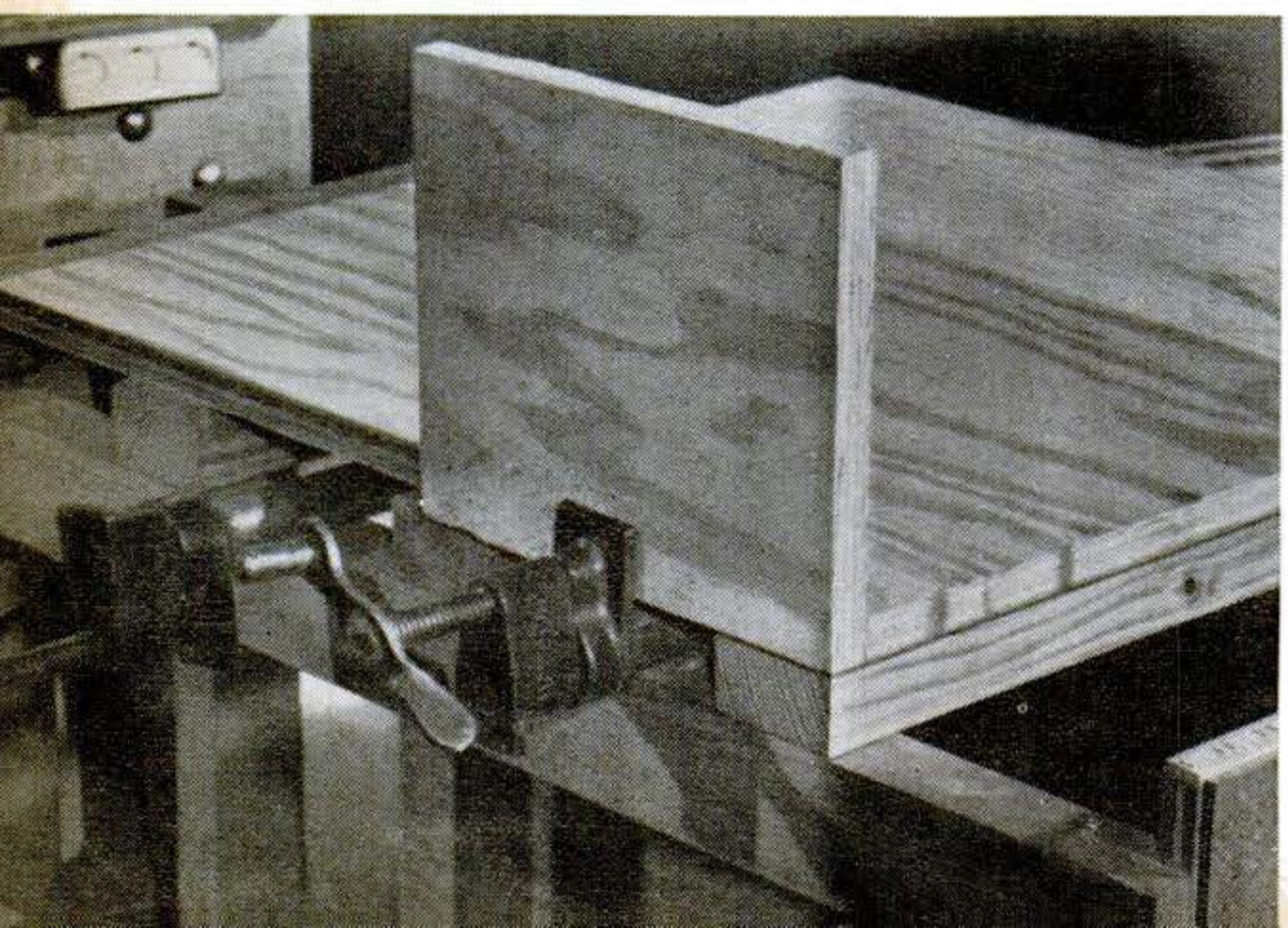
Add the back-rail cleats to which the drawer-top guide will be fastened later, and make the bench top. Use plenty of glue in laminating it, and 1½″ #8 screws 8″ to 10″ apart, driven from the underside. Before putting the bench top together, notch the top piece to receive the cabinet sides.

Screw the top (3″ #14 screws) to the rear rail only; now, the perforated-hardboard back (the next addition) won't be in your way.

Fit the back to protrude about $\frac{5}{16}$″ above the tops of the legs, and fasten it with ¾″ #8 countersunk screws. Installing the perforated hardboard permanently fixes the alignment of the rear legs, so square it up.

With the perforated hardboard in place, finish screwing on the bench top, and add the cabinet sides and top. Fasten the sliding-door track in place with contact cement—this avoids fasteners that might interfere with the doors.

When gluing, clamps are out of the way; the grids hold the work, not the clamps. You saw so blades pass between the grids. Bench holds cut-offs.



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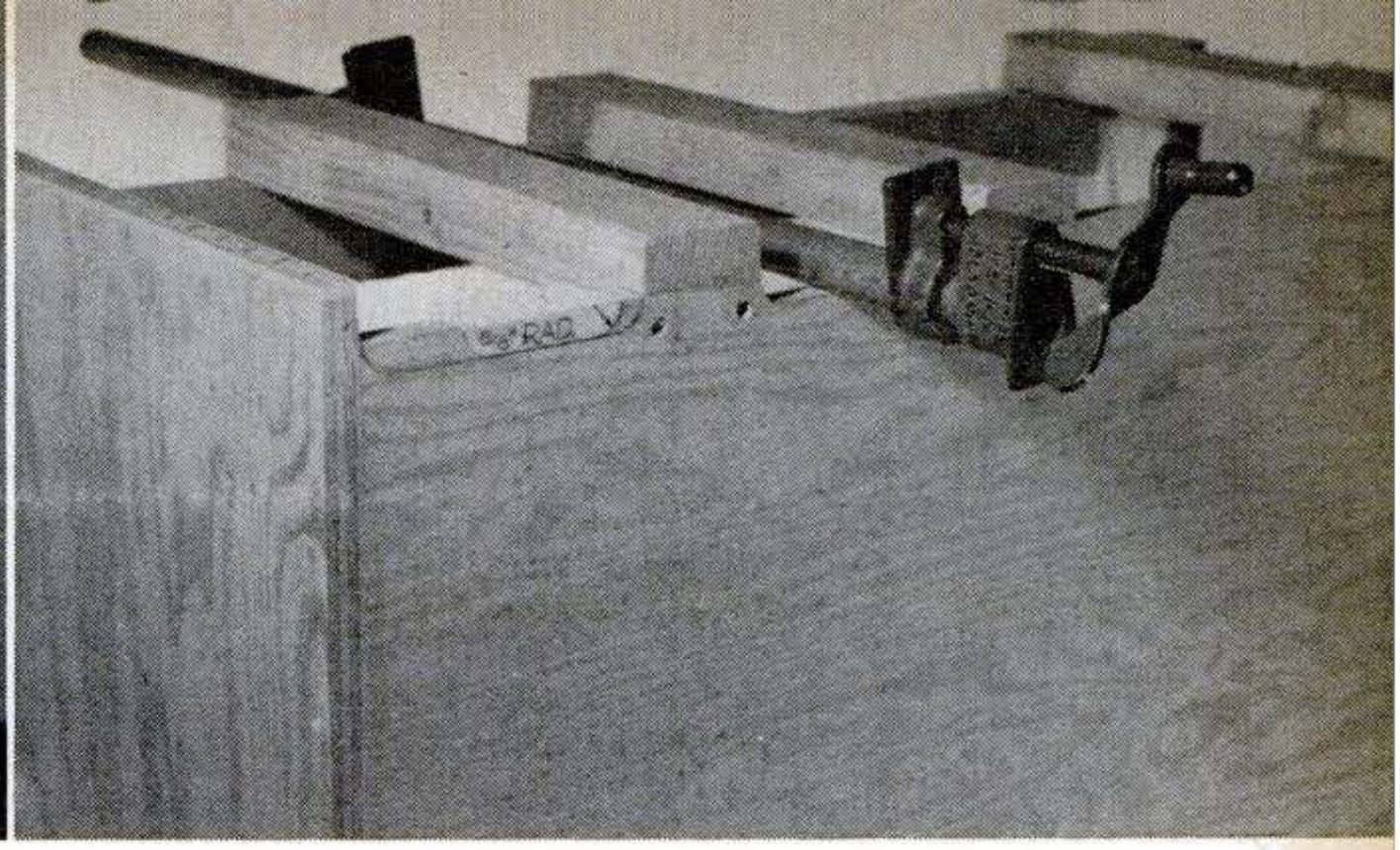
Drill screw holes at sharp angles as above; they'll hold better in end grain. Glue plugs over the screws to cover them and reinforce the thin plywood edges.



Cut out between the grids to let bar clamps drop below the surface. Rabbet the grid pieces carefully so that all work surfaces are level and square.

Tip the bench over so you can work easily on its underside. Add the drawer center guide to the previously installed cleats, assemble the drawer and drawer guides, and, with the drawer clamped loosely in place, fasten the guides to the bench rails.

Drill a hole through the center guide and the bench top, locating it just in front of the inside of the drawer back. A dowel through this hole locks the drawer.

Add the lower rear rail to the bench legs, and glue and screw the shelf to the underside of the bottom side rails.

Turn the bench right side up and install the sliding doors. (Wax their bottom edges with a candle stub.) Fit the doors with a Corbin BPW 6 or equivalent lock—it pushes a pin through the front door into the rear one to lock the cabinet.

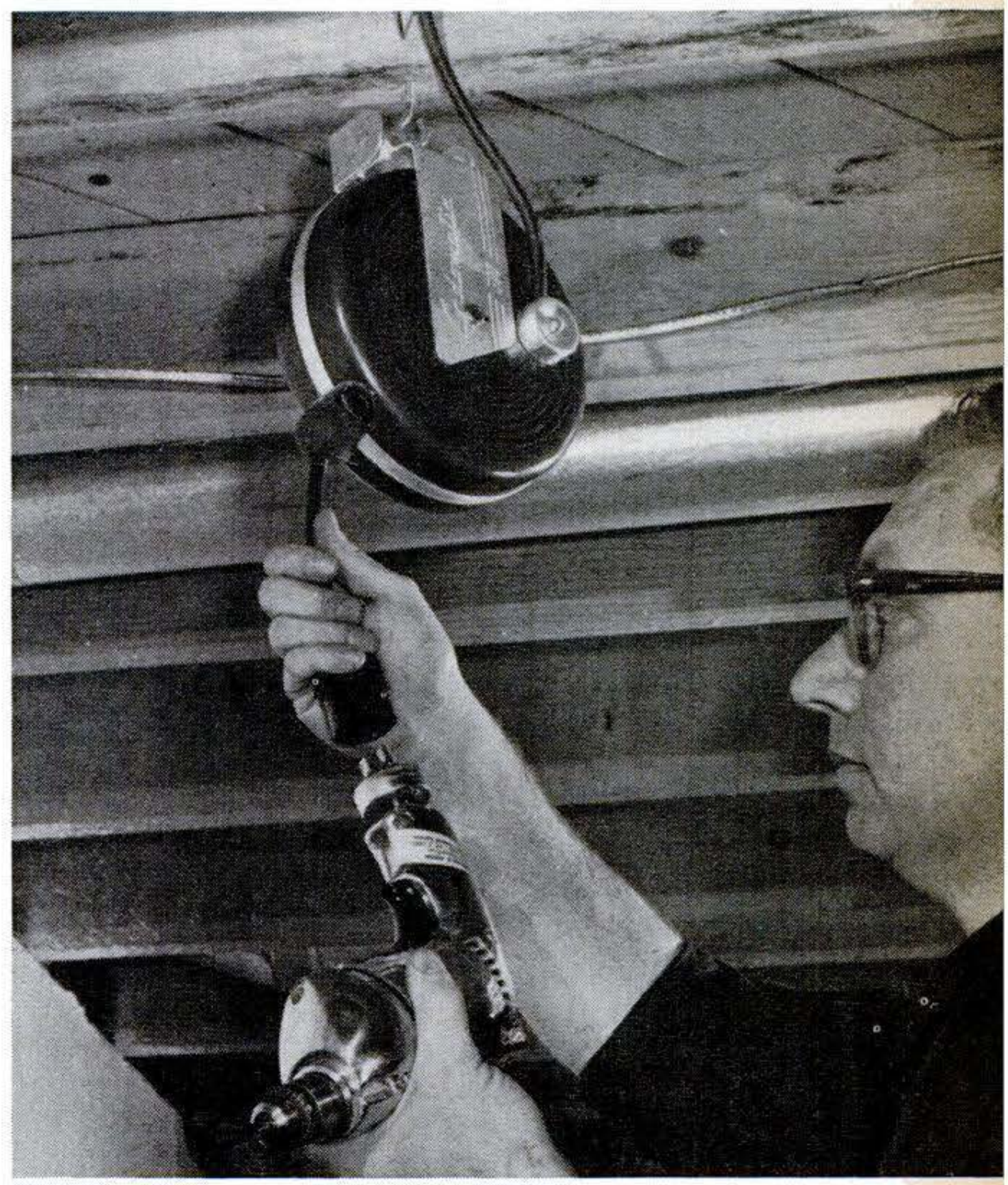
When you build the tool cabinet, use the cabinet back as the spine to which ends, bottom, and top are added—in that order.

Attach the swinging leg to the cabinet as shown in the blueprint. (If the leg swings too freely, shim it with ½″ flat washers slipped over the pipe.) With both the swinging and adjustable legs bolted in position, prop the tool cabinet on a piece of scrap clamped to the main bench legs, and fasten the two components together with 1½″ #8 screws. (Don't use glue; you may want to separate the cabinets.)

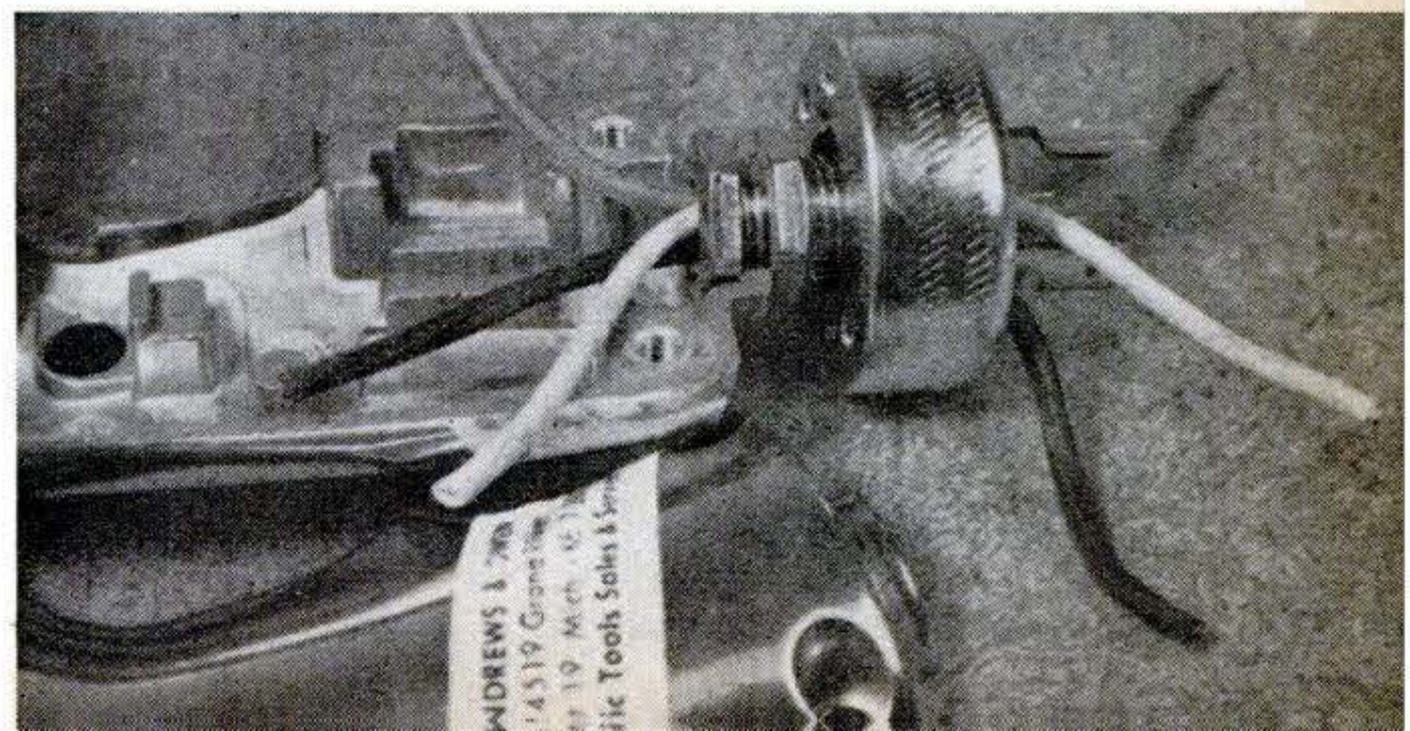
Leave the tool-accessory shelf loose so you can slide it forward for access to items stored at the rear, or pull it out completely. A short dowel glued in a hole in this shelf holds saw blades; stack them on the dowel between layers of cardboard. A series of ¼″ holes accommodate most drills and router bits.

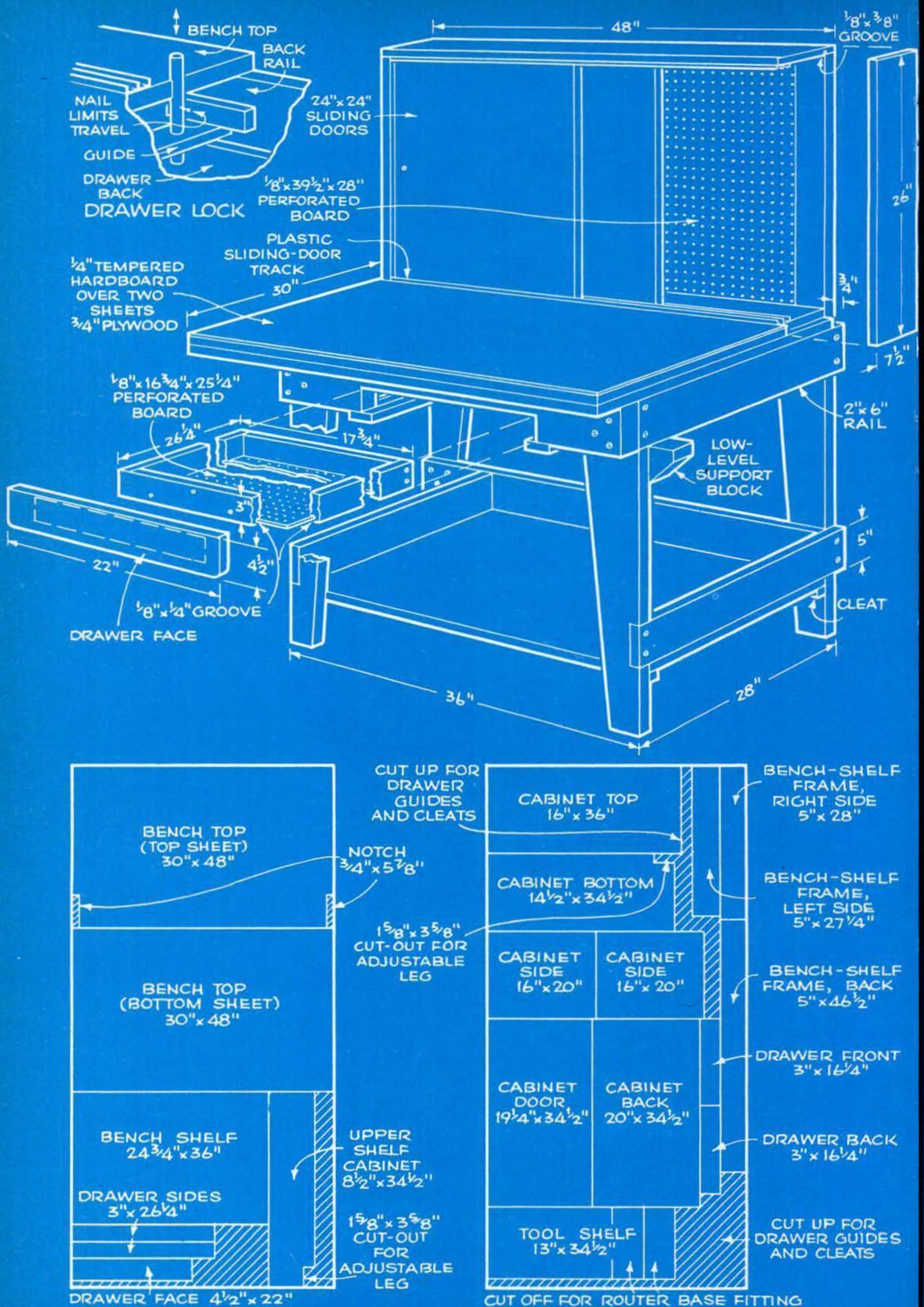
The rolling dolly. Four casters screwed

[*See lie-flat blueprint on the following two pages.*
Text continued on page 226]



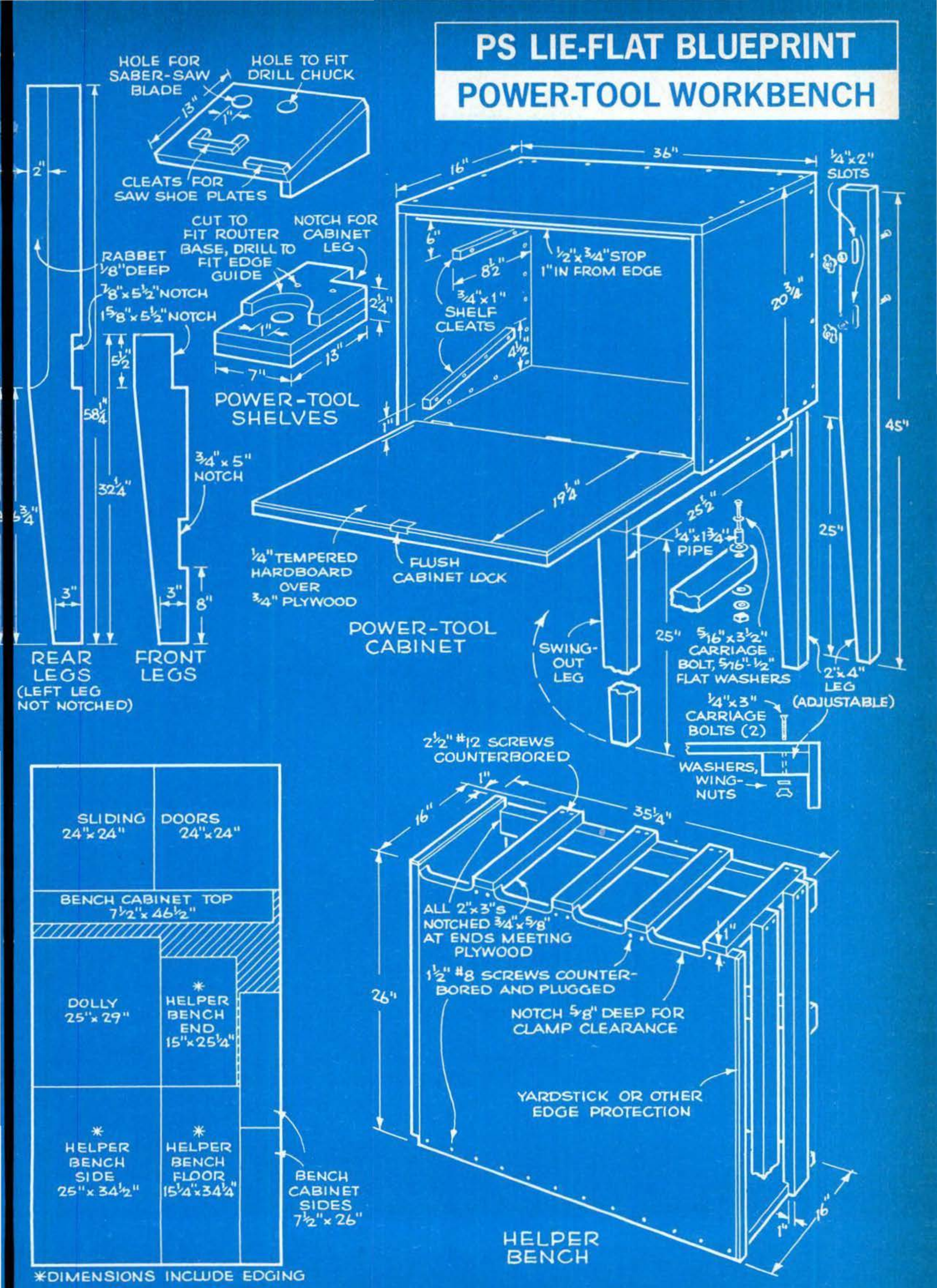
Overhead reel and Hubbell Twist-Lock plugs eliminate the cord tangles you get with lots of power tools. The Cordomatic (above) lets you pull out cord as you need it, automatically winds it up when you're done. You remove the cords from your power tools, attach new plugs with ¼″ pipe nipples (below).




BENCH TOP
BACK RAIL
NAIL LIMITS TRAVEL
GUIDE
DRAWER BACK
DRAWER LOCK
24"x24" SLIDING DOORS
48"
1/8"x3/8" GROOVE
1/8"x39 1/2"x28" PERFORATED BOARD
26"
PLASTIC SLIDING-DOOR TRACK
30"
1/4" TEMPERED HARDBOARD OVER TWO SHEETS 3/4" PLYWOOD
3/4"
7 1/2"
1/8"x16 3/4"x25 1/4" PERFORATED BOARD
26 1/4"
17 3/4"
2"x6" RAIL
LOW-LEVEL SUPPORT BLOCK
3"
5"
22"
4 1/2"
1/8"x1/4" GROOVE
DRAWER FACE
CLEAT
36"
28"
BENCH TOP (TOP SHEET) 30"x48"
NOTCH 3/4"x5 7/8"
BENCH TOP (BOTTOM SHEET) 30"x48"
BENCH SHELF 24 3/4"x36"
DRAWER SIDES 3"x26 1/4"
UPPER SHELF CABINET 8 1/2"x34 1/2"
1 5/8"x3 5/8" CUT-OUT FOR ADJUSTABLE LEG
DRAWER FACE 4 1/2"x22"
CUT UP FOR DRAWER GUIDES AND CLEATS
CABINET TOP 16"x36"
CABINET BOTTOM 14 1/2"x34 1/2"
1 5/8"x3 5/8" CUT-OUT FOR ADJUSTABLE LEG
CABINET SIDE 16"x20"
CABINET SIDE 16"x20"
CABINET DOOR 19 1/4"x34 1/2"
CABINET BACK 20"x34 1/2"
TOOL SHELF 13"x34 1/2"
CUT OFF FOR ROUTER BASE FITTING
BENCH-SHELF FRAME, RIGHT SIDE 5"x28"
BENCH-SHELF FRAME, LEFT SIDE 5"x27 1/4"
BENCH-SHELF FRAME, BACK 5"x46 1/2"
DRAWER FRONT 3"x16 1/4"
DRAWER BACK 3"x16 1/4"
CUT UP FOR DRAWER GUIDES AND CLEATS

PS LIE-FLAT BLUEPRINT

POWER-TOOL WORKBENCH



Colored flagstones cast from concrete form distinctive walk. You can set the stones in sand or gravel.

Birdbath of unusual design is one of a variety of projects you can undertake with colored concrete.

CONCRETE Can

Using readily available pigments, you can change neutral gray concrete into bold colors

By PHIL McCAFFERTY

Changing the neutral gray of concrete to bold colors or pale pastels is easy. You use powdered pigments sold by cement dealers, and only your imagination limits what you can make. You might start with a walk made of colored flagstones, casting the "stones" yourself. Or perhaps you'd prefer to make a useful and attractive accessory for your garden, patio, or entryway.

I immediately saw the wide-open possibilities for making good use of the pigments when the editors of POPULAR SCIENCE asked me to expand an article on casting colored flagstones by W. Forrest Bear and Thomas A. Hoerner. The photos here show some results of our joint efforts with the colored cement.

Three ways are open to you to make use of the pigments. For smaller projects, you might combine them with premixed sacked concrete and existing or easily built molds. You might also want to have molds, forms, pigments, and project ideas ready for use of leftovers if you're planning a ready-mix concrete delivery. Or for really large projects, you can mix your own colored concrete from scratch with sand and cement.

The pigments are mainly metallic oxides. They range in price from about 40 cents a pound for yellows and reds to about $1.30 per pound for greens. A few pounds of pigment will color a lot of concrete, and there are tricks to make the color go a long way.

About two pounds of pigment will fully color a bag of premix. The same two pounds of pigment will color the surface of about 30 square feet of concrete, using the sprinkle-on method. Buttered ½" thick over the top of plain concrete, a two-pound colored concrete mixture will cover about 12 square feet. The

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Set off flowers and plants with pots and planters cast in plastic pails and other readily available forms.

Be Colorful

latter two ideas are thrifty ways to make flagstones where the uncolored sides will never be seen.

Making hollow things. Colorful planters, flowerpots, and giant ashtrays heavy enough to stay put are things that come easy with colored concrete. Use plastic wastebaskets or graduated mixing bowls for inner and outer forms. Tapered sides allow you to remove the casting without damage to the plastic utensils. Push eyebolts in wet concrete rims for hanging baskets.

For oblong objects, try a loaf pan to shape the inside, a simple wood frame to form the outside. Line the wood frame with decorative moldings, random wood scraps, crumpled aluminum foil or plastic wrap to make interesting patterns on the face of a casting. Another trick is to place small shiny stones or bits of colorful ceramic tile on the mold's surface. To hold them on the sides of a mold, use water-soluble glue. Rock salt washed out of a cast surface forms pock marks. Scraps of patterned sheet plastic lining the inside of

Continued

WHAT TO USE FOR COLORED CONCRETE

Color You Get	Powdered Pigment to Use
	Lampblack, carbon black, black manganese oxide, or black iron oxide; use also for blue-blacks and grays
	Ultramarine blue
	Red iron oxide. Shades available will vary
	Red iron oxides, mineral turkey red, Indian red
	Brown iron oxides or burnt umber
	Chromium oxide or blue-green ultramarine
	Yellow iron oxide or yellow ochre; these also produce buff
	Reducing pigment concentration by a third to a half produces pastel shades
	The same pigment added to white and to gray cement produces different tones

How to determine final color. Aggregate and cement color influence appearance, as do kind of pigment and concentration used. If exact final color is important, prepare test samples. Cure for about 5 days to see final effect. Pigments may be mixed to get special shades.

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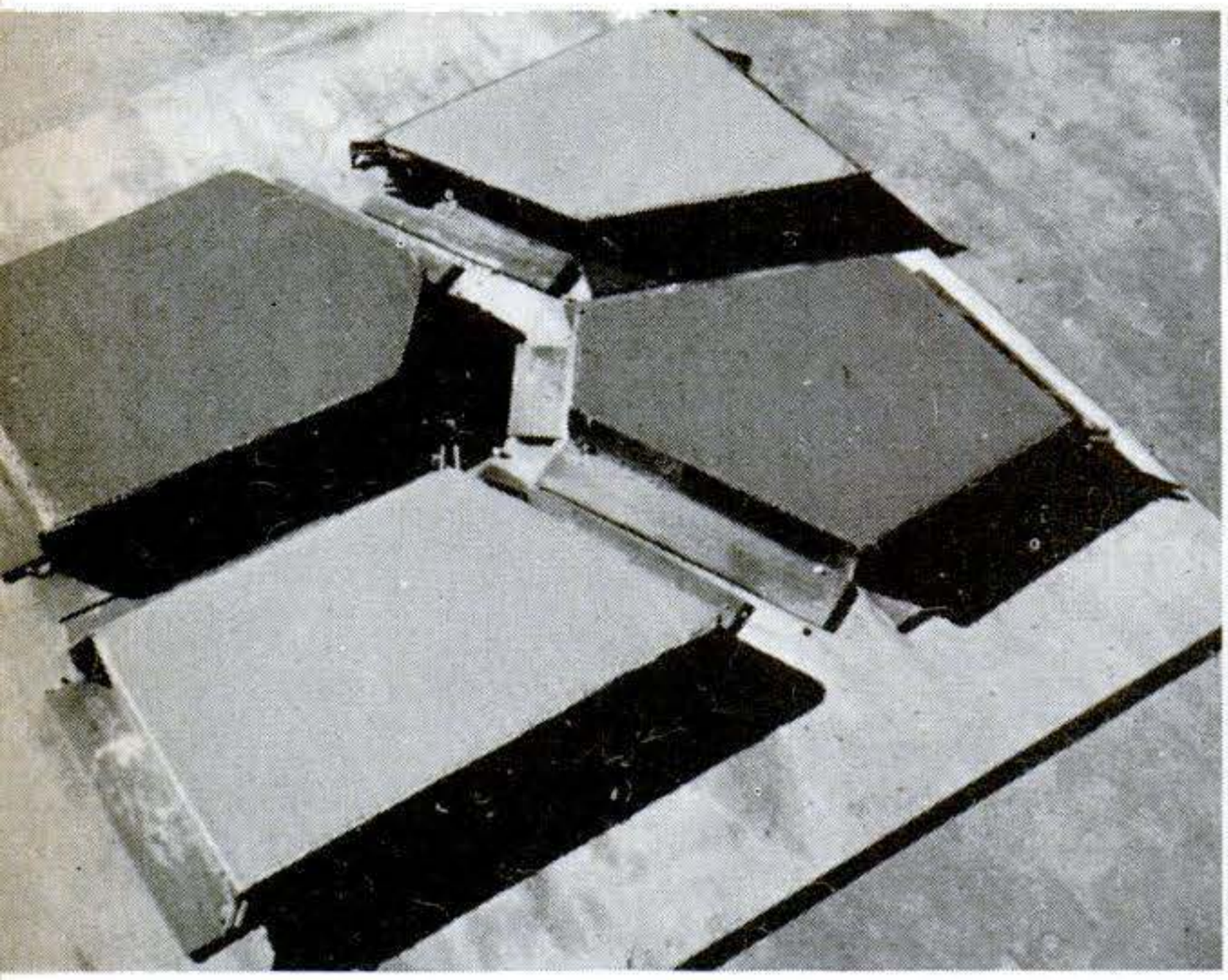
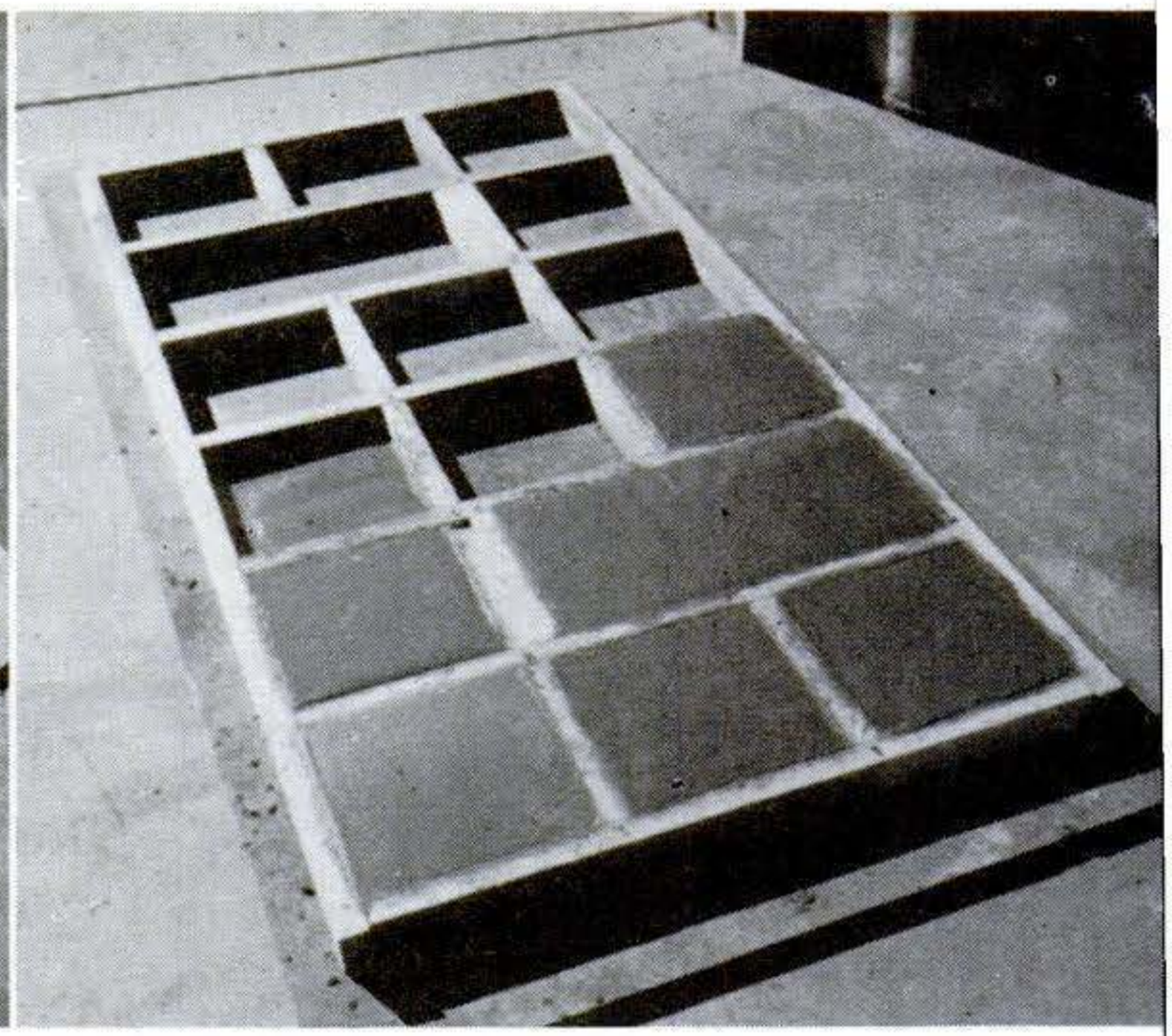
With a few simple techniques, you can cast colored-concrete project



Keyed random flagstones can be cast in angle-iron forms. Use reinforcing in the larger patio stones.



Mass-produce patio blocks on a sheet of hardboard or exterior plywood. Form edges with wood strips.

molds imparts a design to your casting. Wood, hardboard, metal lawn edging, and steel angle are a few of the things that can be used to fashion your own molds and forms. So long as there are no undercuts, one-shot molds can have straight sides. But be sure to make provision for knocking the molds apart for removal of the castings. When several castings are to be made from one form, slant the sides about seven degrees for easy removal.

Flagstones should be 2½″ to 3″ thick, large slabs the thickness of the depth of a two-by-four. Forms should be watertight to prevent escape of moisture, and rigid enough to retain their shape when filled.

Oil the forms to aid in removal and for moisture retention. For colored concrete, a paraffin oil is better than engine oil. If the bottom of the form is open, casting should be done on a compacted and well dampened sand base or on a plastic sheet.

Color all through. You can add up to about 10 percent of the weight of cement in coloring pigment without affecting the strength of the concrete. This works out to about two pounds of pigment per bag of premix, or nine pounds per bag of cement if you mix your own concrete. Less may achieve the shade desired. Full-strength pigments generally produce rich colors at about seven pounds per bag of cement, 1½ pounds per bag of premix, depending on the pigment. Reducing these quantities by a third to a half produces attractive pastels. Powdered pigments should be thoroughly mixed with dry concrete before water is added. Dry colors will fool you. So make a sample.

If you mix your own concrete, try proportions of 1 part cement, 3 parts sand, and 2 parts water by volume for pouring small castings. For flagstones or slabs, where more strength is desired, this base mix is recommended: 1 part cement, 3 parts sand, 3 parts gravel, 2 parts water.

To add coloring to ready-mix concrete, mix the pigment with just enough water to make a thin paste and add it to the mixed concrete. As pigments tend to lump, this procedure insures even coloring. Full-strength colors are achieved by adding about 1½ to two pounds of pigment to a cubic foot of ready-mix.

Sprinkle-on color. Fill the form with regular concrete or ready-mix and spade the material near the edges to eliminate voids. Screed off excess concrete to level the surface. A wood float can be used to work the surface and move larger aggregates down. Permit any surface water to evaporate.

Mix a bit of sand and cement with the pigment and sprinkle evenly on the surface. Trowel in one direction for the most uniform color. This method of coloring concrete is the least expensive but it takes

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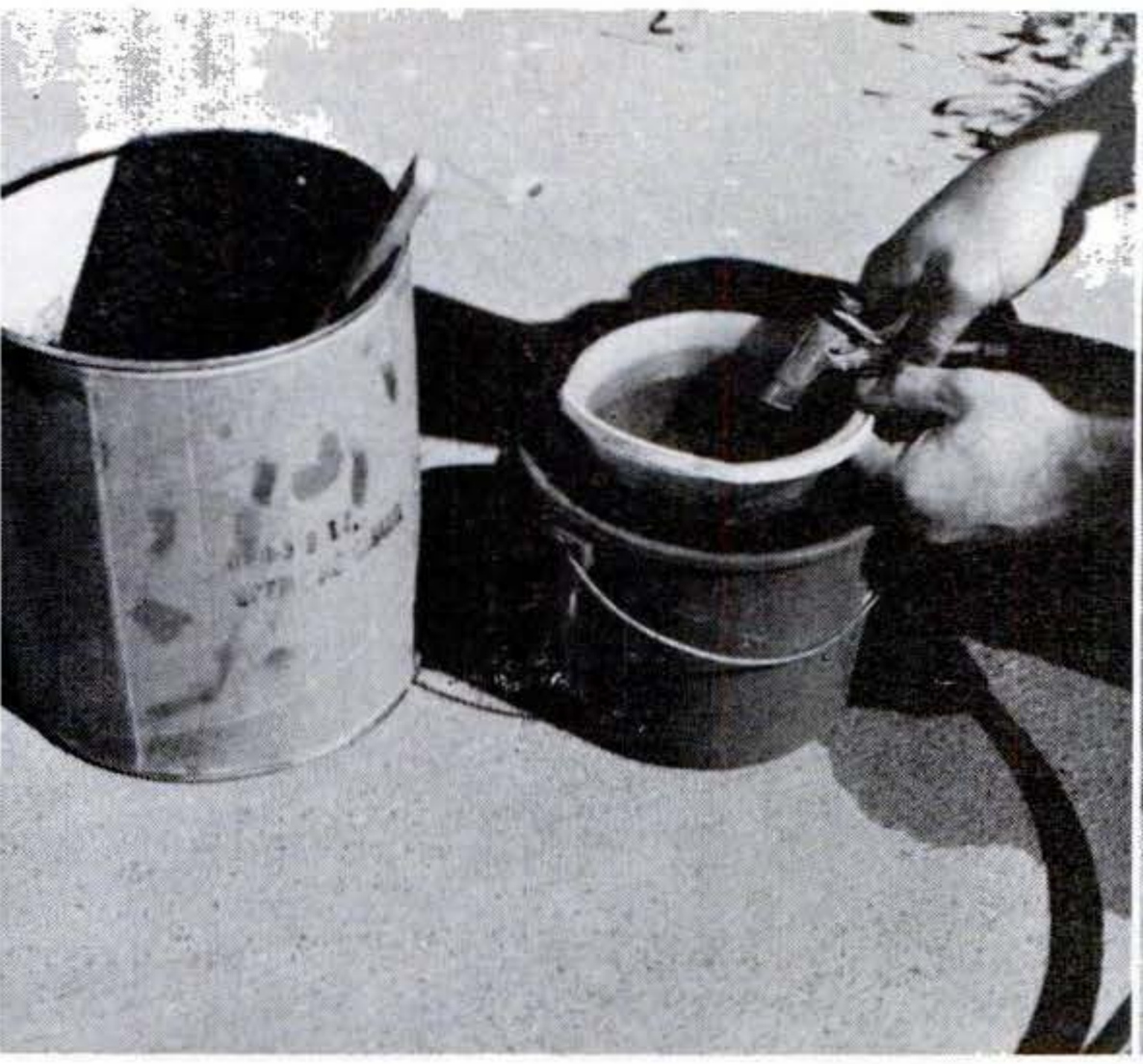
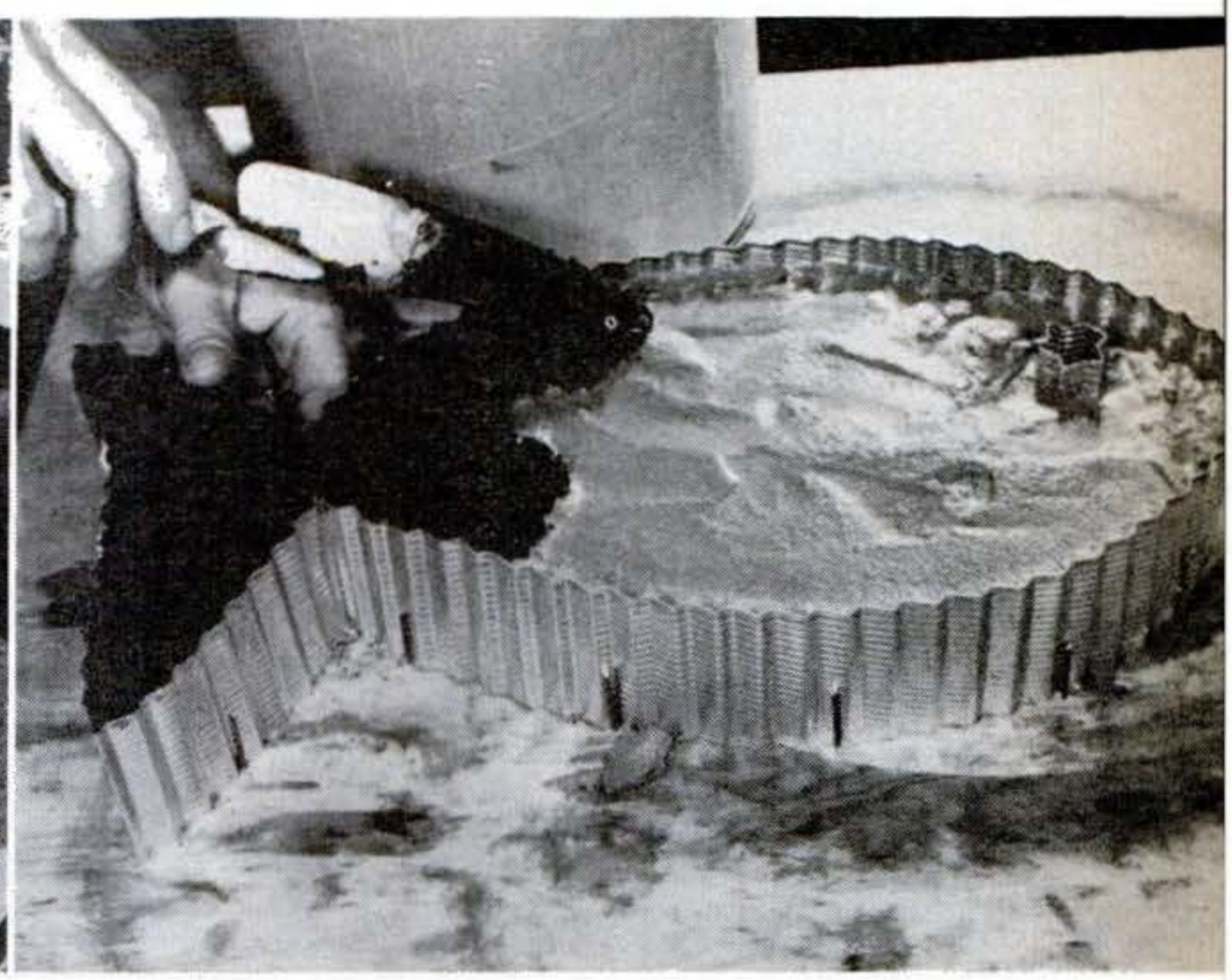
deep bold shades or in delicate pastel tints



Plastic pails and wastebaskets will stay in place to form a hollow in cast items if filled with water.



Stretch pigment by topping regular concrete if edges won't show. Lawn edging is a handy form.

skill and patience. It gives the least control over the shade of color. You can buy premixed sprinkle-on colors.

Topping method. Screed off regular concrete about ½″ from the top of the form. After the surface water has evaporated, butter the surface with a topping of 3½-9 pounds of pigment (depending on material and shade desired), one bag of cement, 200 pounds of dry sand, and about five gallons of water. This will cover about 50 square feet ½″ thick. Level the topping with a magnesium trowel or wood float. This is more expensive than the sprinkle-on method. However, uniform coloring is obtained, and the surface is longer wearing.

Use white cement for pure colors. Gray cement and common sand and gravel muddy the shade of colored concrete—particularly yellow and the pastel shades. For clear colors you may want to use white cement and sand, or premixes of these.

Casting, finishing, and curing. So long as all aggregate is covered with a liquid cement mixture, the less water used the stronger the concrete will be. Thorough ramming or spading of the concrete will allow you to use a fairly stiff mix and still fill out mold detail. Reinforcing is desirable in all concrete castings. Hardware cloth can be fashioned to strengthen them.

A smooth surface is achieved with a metal trowel. A wood float gives a rough finish. Trowel first and brush with a hairbrush or broom for a scratched surface.

Castings should be wetted down with water and covered with plastic film for better hydration, which makes better-quality concrete. Leave the concrete in the mold or form for at least three days—up to two weeks for the strongest concrete and least chance of damaging fine mold detail.

Continued

Cast colored posts in greased cardboard shipping tube. Center reinforcing bar with wadded paper.

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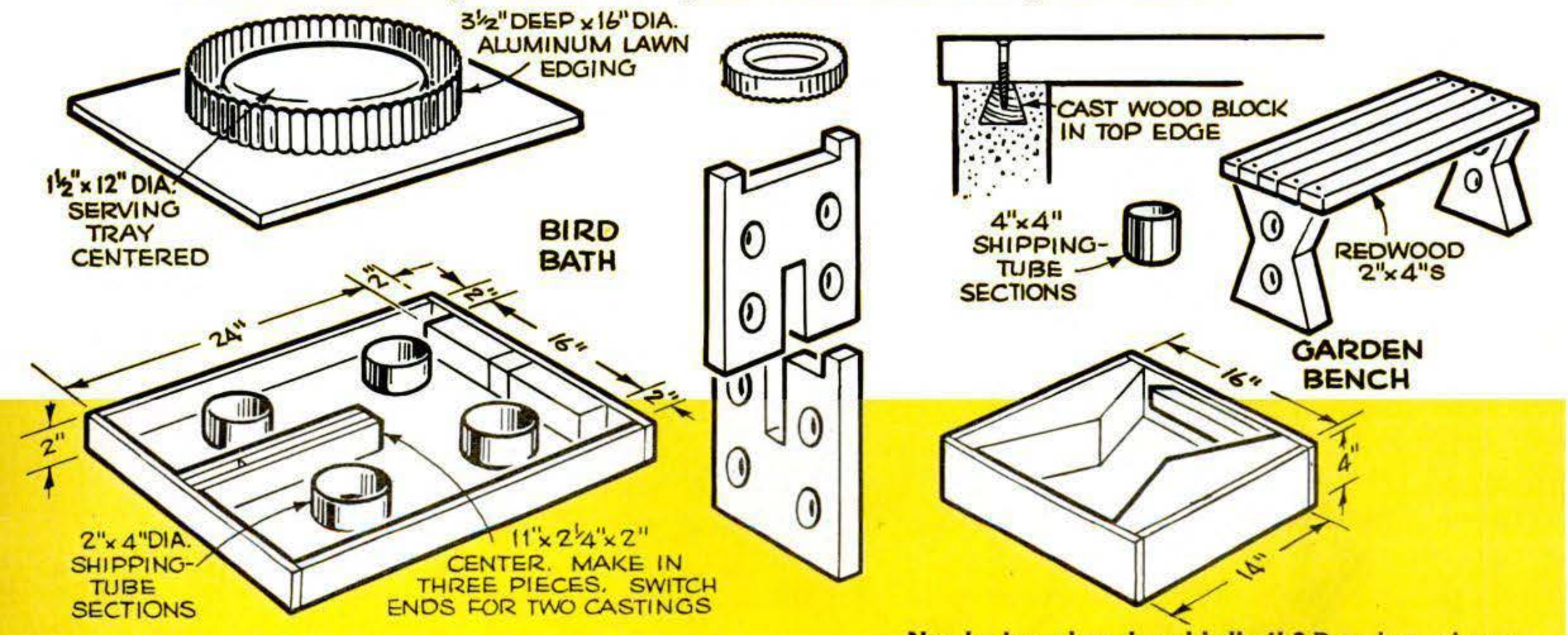
Spray-on products are also available to prevent escape of water during curing.

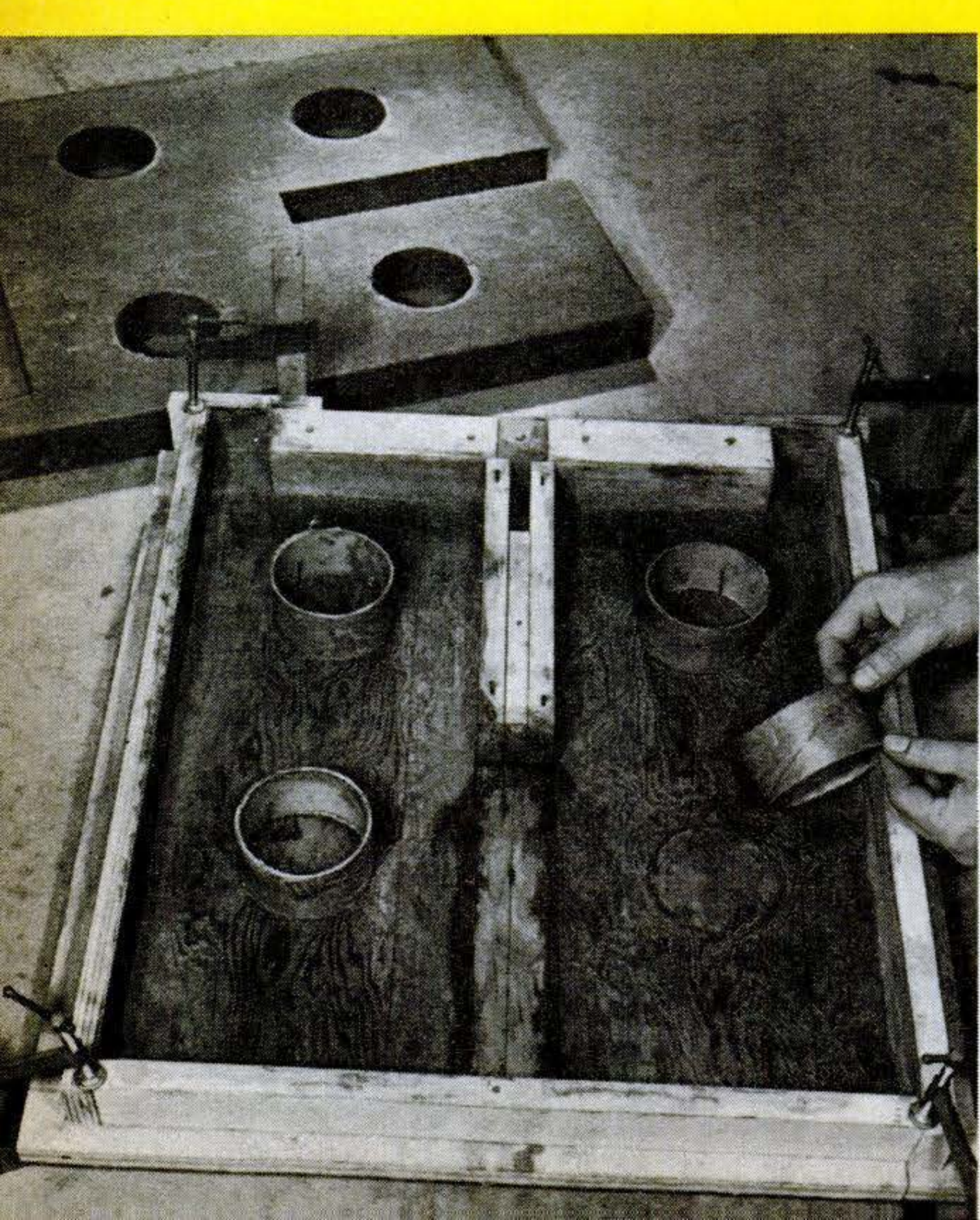
Scrub the cured concrete with a stiff brush and water to remove oil and surface oxidation. Concrete sealers or waxes will better preserve the colored projects.

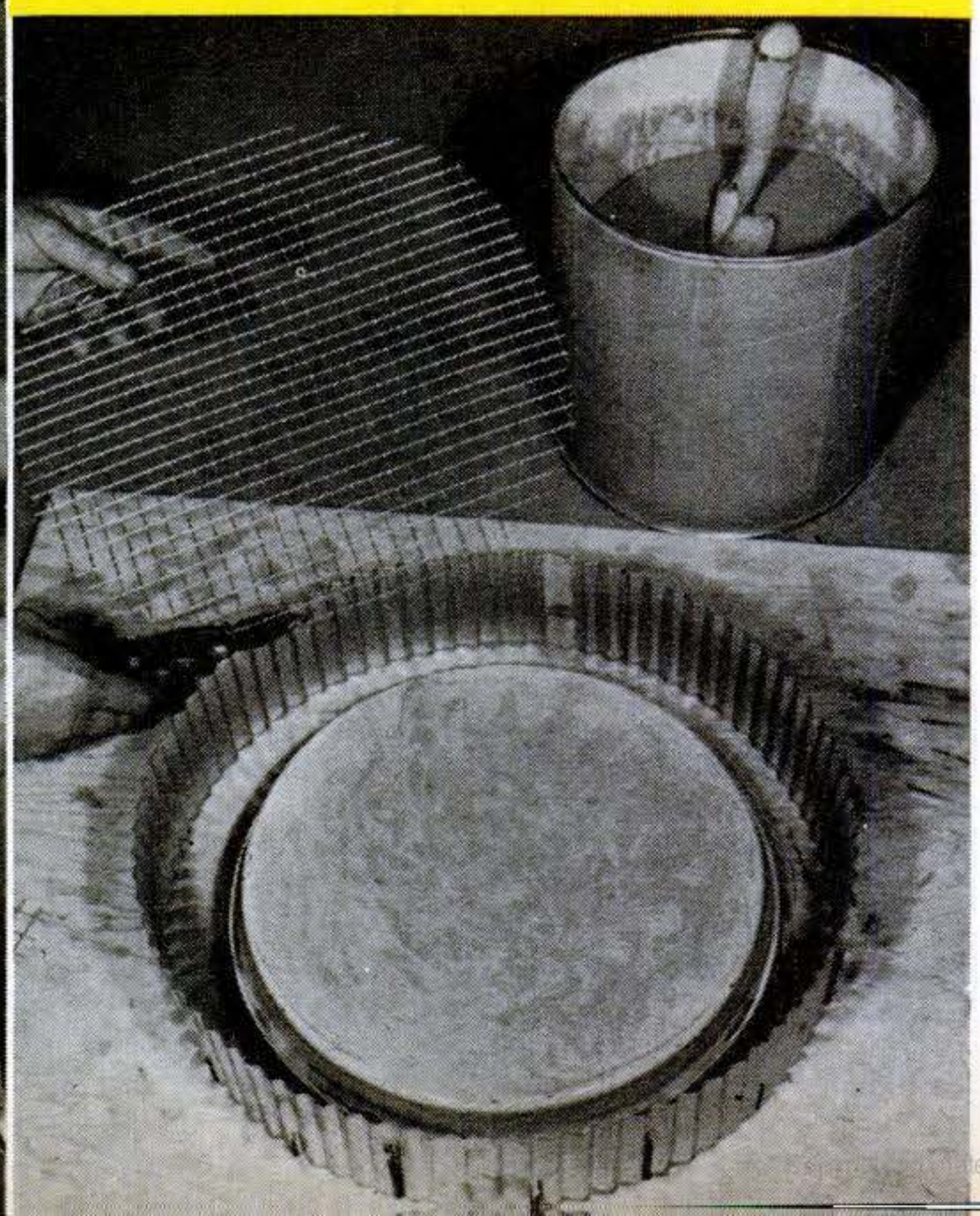
Who has the pigments? Here are some firms: 3M, 1000 Fauquier, St. Paul 55106; Ceresit Co., 3225 S. Shields, Chicago 60616; Filo Color & Chemical Corp., 347 Madison Ave., NYC 10017; A. C. Horn Co., Horn-Sun Bldg., Long Island City, N.Y.; Landers-Segal Color Co., 74 Delevan, Brooklyn 31, N.Y.; Mineral Pigments Corp., Muirkirk 1, Md.; Ricketson Mineral Color Wks., 229 E. Wisconsin, Milwaukee 2; Utility Color Co., 399 Frelinghuysen, Newark 5, N.J.; Williams Colors Division of the Charles Pfizer Co., 235 E. 42nd St., NYC 10017. PS

Two colorful eye-catchers you can make for your lawn



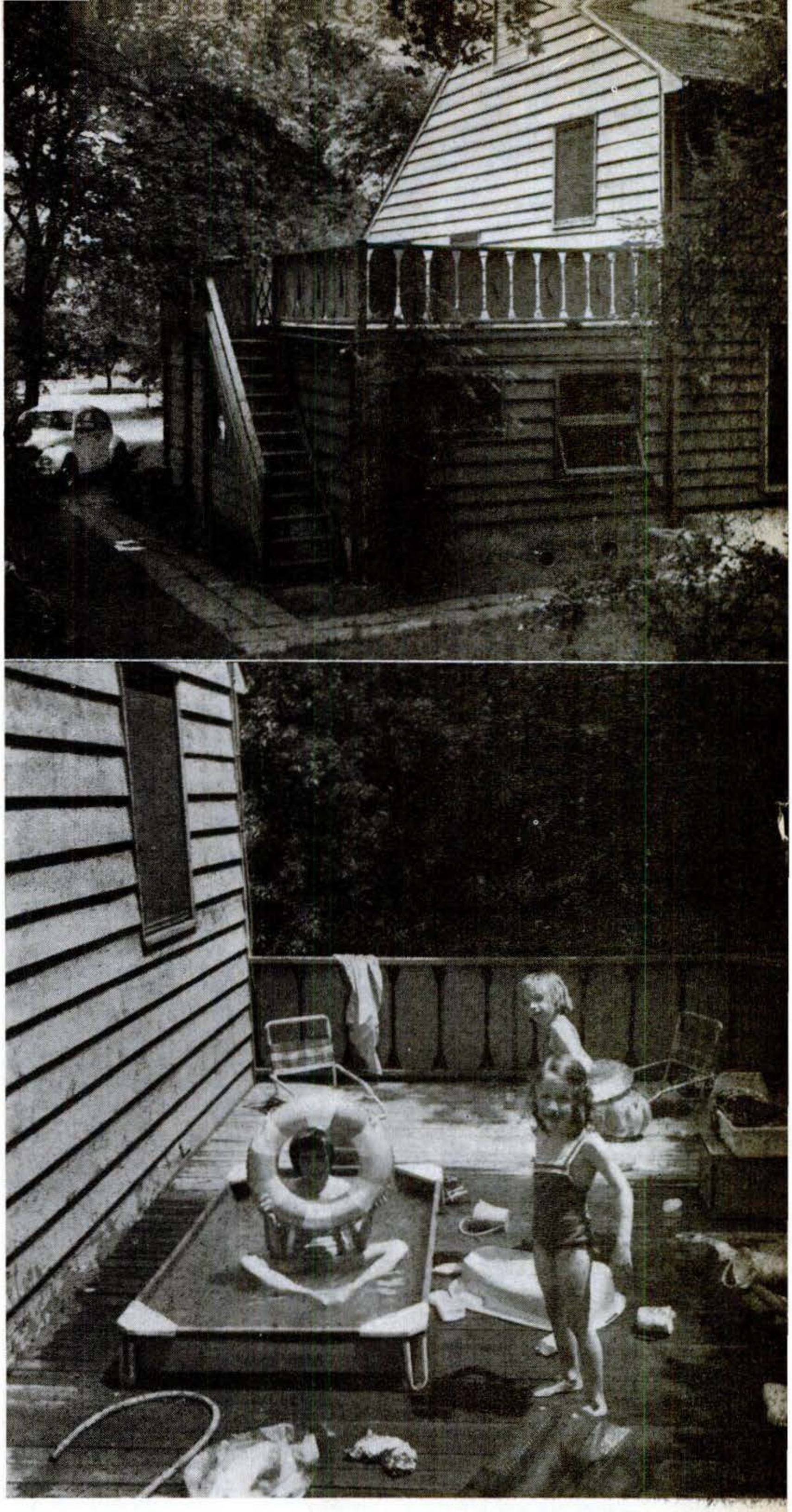
Need a lawn bench or birdbath? Drawings above give details for both; in photos below are steps for casting the bath shown in color on first page. Directly below are serving tray and aluminum lawn-edging form that are used to cast the bath. Smooth off tray rim with modeling clay. To permit removal, three blocks form top recess and center notch of pedestal parts.





IMPROVE YOUR HOME

Rooftop Playground Puts Our Kids in the Sun



Our beautiful tree-filled back yard posed a problem: It has no sunny play area where we can set up a wading pool. But the sun does shine on our flat garage roof. So we turned the roof into a play deck for the children.

It's reached by an outside stair we built first. For the deck we used No. 2 pine with two coats of wood preservative. This is cheaper than rot-resistant wood such as cypress—and just about as effective with planks spaced to give quick water run-off without trapping toes and fingers. The 45″-high safety railing around the deck actually enhances the appearance of our house.

We were lucky to have a load-bearing garage wall adjoining the house. Without it, you'd need bracing to support a number of adults and any considerable weight of water.

The whole job cost us about $250 and six days' work, a small price to pay for a private, sunny, mudless, and escape-proof play area, plus a dining deck at sundown. *—Mr. & Mrs. R. Ruthman, Darien, Conn.*

For dealers in home-improvement materials, see page 216

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"If you have so little confidence in us," said th

GUS DISAGREES WITH A

Gus felt funny about invading a dealer's service department but his job was to save the car —not the manager's feelings

"Keep right, Fred—right! Oh gosh, now we can't make the exit," muttered the girl as the sedan rolled alongside a truck and an exit ramp appeared on the right.

Tight-lipped, the young man who was driving sped past the long trailer.

"Should have told me before we got to it," he grumbled. "It's sure too late now."

"I know," she said miserably. "I thought you'd remember. Now we have to go six miles out of our way and six back."

Fred looked in the mirror. Well ahead of the trailer, he returned to the right lane, slowed, and pulled onto the shoulder. As the car stopped, the truck and a long string of traffic behind it roared by.

"What's wrong now?" the girl asked.

"I've had enough of the seeing-eye bit," Fred snapped. "You know this turnpike, and it's your Dad's car, so you drive it."

He put the shift into neutral, opened the door, and began to get out.

"You're just sore because you couldn't take your Ghia," retorted the girl, hitching herself over the seat.

Fred was already walking around. She swung one foot over the floor hump, and suddenly the idling engine roared. Fred leaped in alarm, but the car didn't budge, though its engine reached a screaming crescendo before the young man could go around and tear the door open. The girl was halfway across the seat, one leg bent oddly, her foot, in a high-heeled shoe, awkwardly jammed on the gas pedal.

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dheaded man, "you'd better pay for the tow and diagnosis and have your crate hauled out of here."

DIAGNOSIS

By MARTIN BUNN ILLUSTRATION BY RAY QUIGLEY

"Turn it off, Lucy!" Fred yelled above the banshee howl of the motor.

White-faced, she did not move. Before Fred could reach the switch, the engine stopped like a sound tape snipped short. In deafening silence, he turned off the ignition, then worked the girl's foot free.

"Move over, Lucy," he said gently. "I guess you won't want to drive just now."

He sat behind the wheel fully half a minute before turning the ignition key.

A dull thunk was the only response.

Switching off the ignition, he put the shift lever into high, then got out and tried to rock the car.

"Shoulder's too soft," he muttered, getting in again. Once more he tried the starter. Again there was a dull thud.

"That's it," said Fred. "We're stuck until somebody sends a tow truck. Let's have your scarf to tie to the door handle."

A stocky, square-jawed man in a sports coat was pacing before the Bensen showroom as Gus stopped the Model Garage tow truck at the curb.

"I'm Herb Radcliffe, who phoned you," said the man. "I wanted to meet you out here to talk before we go inside."

"Okay, I'm listening," answered Gus.

"My daughter and her boy friend were going upstate last weekend in my Chevy. He was driving, but on the way they decided to change off. In sliding over, her foot jammed the gas pedal and the engine almost ran off its mounts. Before they could stop it, it quit and wouldn't start again.

"Lucy had it towed here because it's where I bought the car. I wouldn't let them fix a tricycle myself. They once charged me for work that should have been under the warranty. So it's the money, not just the princi-

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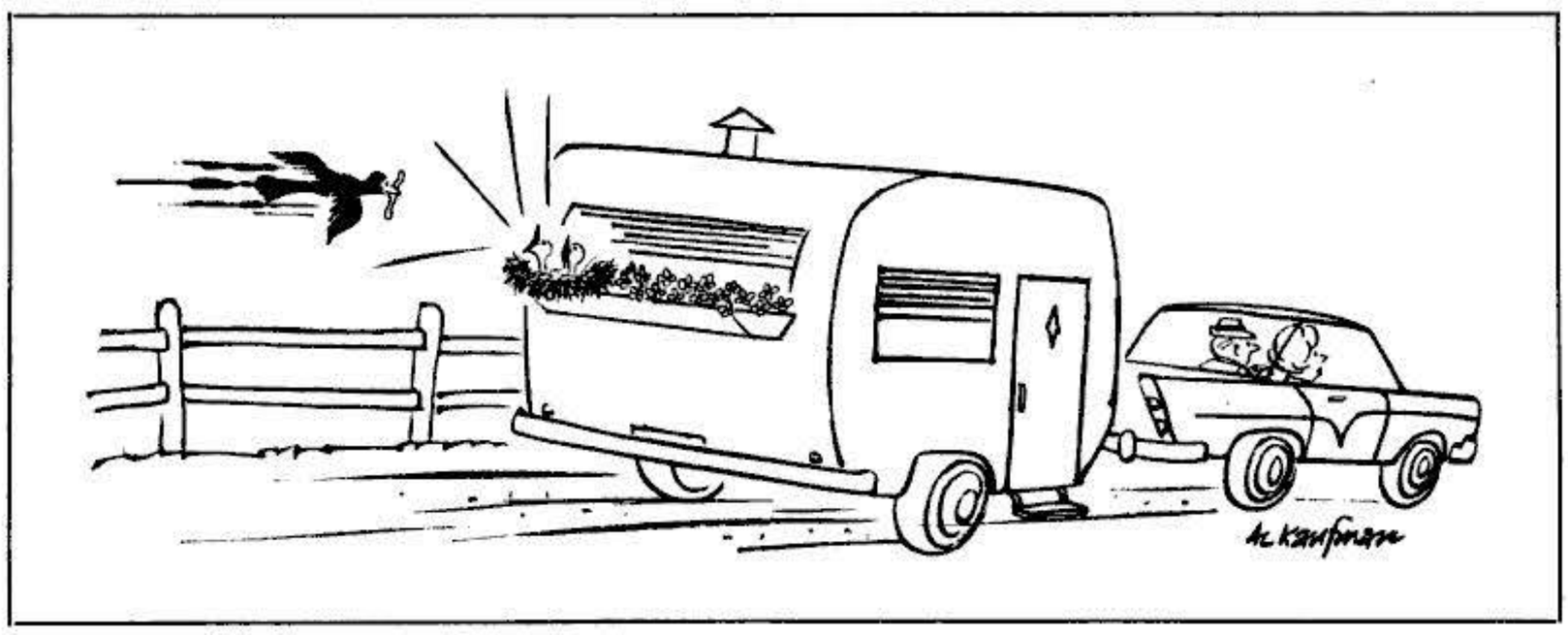
ple of the thing," confessed Radcliffe, "Anyway, it's getting old. I was going to let Lucy take it back to college for her last term, then trade it in next year, so it isn't worth spending much on."

"Did they say what's wrong?" asked Gus.

Radcliffe shrugged. "They're guessing. They say my daughter must have panicked, tried to switch off the engine, and turned on the starter instead, jamming the starter and flywheel teeth. They say the solenoid's probably shot and the flywheel teeth are broken, so the car'll need a new flywheel.

"But Lucy and the boy swear she didn't touch the key—the engine stopped by itself. I told the service manager that I wanted to call in another expert. He didn't like it, but here we are. I'll pay whatever you think right for anything you do."



As they entered the repair shop, a big redheaded man frowned at them angrily.

"I told you what we decided," he said.

"I told *you* I wanted somebody to backstop you," retorted Radcliffe. "Here he is."

"If you have so little confidence in us," said the redhead, flushing, "you'd better pay for the tow and diagnosis and have your crate hauled out of here."

Gus went out to get the tow truck.

Back at the Model Garage, Gus tried the starter of the Chevy. The thunk was exactly like that heard from the solenoid when the battery is too weak to crank the starter. But a hydrometer read 1,260, and all battery, solenoid, and starter connections proved to be clean and secure.

On a load-meter test, the battery fell only to 10 volts under a 200-ampere draw, confirming that it was in fairly good shape. Propping the meter where he could see it, Gus turned the key again to "start." The needle dropped to three volts, indicating the heavy draw of a locked armature.

Gus disconnected the meter, then loosened the starter. It came off with no indication of jammed teeth. On a test bench, he connected it and the solenoid to a 12-volt battery. Both worked perfectly.

After removing the power-steering belt, he tried to turn the engine by hand. It wouldn't budge. Crankshaft and block might as well have been one solid chunk.

Gus removed the spark plugs, and mixed a pint of penetrating oil with as much kerosene. With a siphon bulb, he squirted a few ounces into each cylinder, then replaced the plugs and the starter.

Late in the afternoon, a saucy horn announced the arrival of a sleek little sports car. The young man who stepped out of the black Karmann Ghia glared at the Chevrolet.

"I'm Fred Clark. I was there when that bus conked out. Any luck with it?"

"Too soon to tell," replied Gus.

"It would never have happened if this glorified VW hadn't let me down." He jerked a thumb at the Ghia. "Lucy Radcliffe and I go to the same college, and I drove her home in my car. On the throughway, it began missing at high speeds. We had to poke along under 50.

"We stopped to put in new points, plugs, even a condenser. It still missed. I got a new coil and plug wires, and put on a spare fuel pump I carry. Nothing helped. It runs fine cold, but as soon as it warms up you're back to 50 per."

Gus raised the engine deck, lifted off the distributor cap, and turned the little engine over to bring the breaker point on a high spot of the cam. The gap checked out at sixteen thousandths.

"Let's take a ride," he suggested.

Acceleration was good through all gears. Gus tentatively ruled out a clogged exhaust system, dirty air cleaner, sticking choke, and defective vacuum advance. A mile's run warmed the engine and brought them to an expressway. As Gus opened the throttle, the little car leaped forward, reaching 65 with plenty of pedal left. But half a mile later it suddenly faltered, dropping

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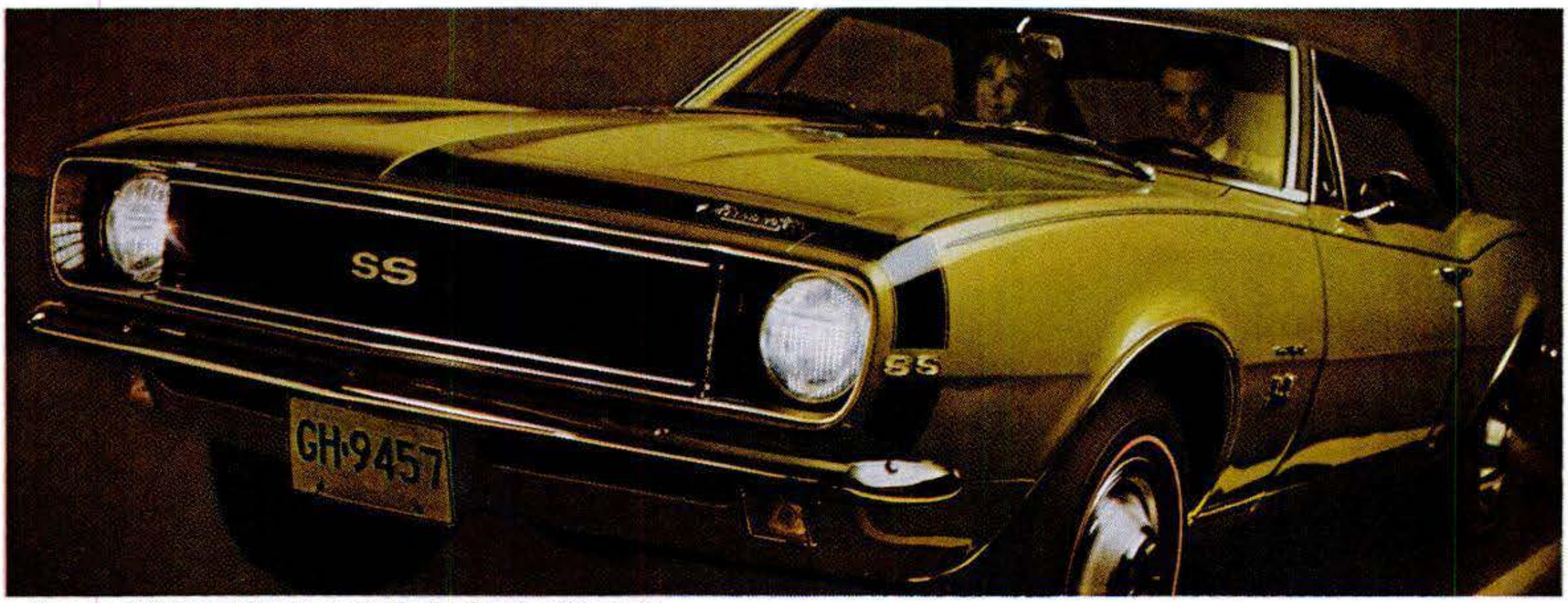
Camaro SS: the 396-cu-in version!



Camaro SS Sport Coupe with Rally Sport equipment

Camaro's free spirit was just made for a big-chested V8 like the 325-horsepower Turbo-Jet 396. So we put them together in a new package. That's the only way we know to step up from the 350-cubic-inch Camaro SS.

For show there's a stripe around the snout, SS emblems, domed hood and a black rear body panel. For go there's a special suspension with beefier springs and shocks, special lower ball joints and rear axle radius rod.

And hear this: you can order the three-speed Turbo Hydra-Matic with this one. Yeah! But don't just sit there reading about it. Hustle down to your Chevrolet dealer's and look at the sportingest setup this side of Corvette.

CHEVROLET

GM

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rapidly below the 50 mark. There it cruised smoothly, but when Gus floored the throttle the car surged forward only momentarily.

It felt like fuel trouble, Gus thought as he headed back. If the ignition were cutting out—because of point bounce, say—the car would hold that critical 50-m.p.h. speed without responding to more gas as it did. Unless both fuel pumps were defective, or pump stroke too short, the trouble must be in the carb. Or the fuel line—which had, Gus recalled, a vulnerable link in it.

Back in the shop, he jacked up the left side of the car, then slid under it.

"What're you looking for there?"

"Your high-speed miss," replied Gus, emerging, some limp tubing in his hand.

"This connects the gas line from the tank to one that goes through the front wall of the engine compartment," Gus explained. "It's synthetic rubber, gone soft with heat and age. When the fuel pump pulls a lot of gas at high speed, the tubing collapses and chokes off fuel as if you'd pinched it. At lower speed the suction is less, so it passes gas."

"Why did it work with a cold engine?"

"While cold, the tubing was stiff and didn't collapse. I'll put on a new piece."

On the second road test the Ghia hit 80.

At noon next day, Radcliffe appeared.

"Heard you licked Fred's trouble," he said. "What's the word on my car?"

"Let's go try it," suggested Gus.

He got into the Chevy and turned the key. There was a thunk, a hesitation, and then the starter ground sluggishly. In a second or two, it turned faster. Suddenly the engine fired, with a belch of blue smoke. The oil-warning light blinked off.

"Migosh!" gasped Radcliffe at the bluish exhaust. "It never did that before."

"That's just some solvent oil I put in burning out," Gus assured him. Clapping an exhaust hose to the tailpipe, he let the car idle for a short time, then drove it onto a lift and cut the engine.

"The parts seized," Gus explained to Radcliffe, "because the throttle was full open for too long at such high revs they didn't get enough oil. When the existing oil film was scraped off, tiny hot spots practically welded themselves together."

"Why did the oil fail just because the engine was revving up? I've had this car do 90, and cruise all day at 75."

"It never revved up as fast, even at high road speeds, as it did running with no load," returned Gus. "It threw off oil mighty fast, and at that speed the oil-pump output tends to fall off because of cavitation —that is, the pump spins a hole in the oil instead of moving the stuff along."

"You think it did the engine any harm?"

"It didn't improve it any—probably took 30,000 miles out of it. In 10,000 or so more, it may start pumping oil."

"But it's okay for now?"

Gus nodded. "I'd change the oil—that engine needs the best of lubrication now—add a pint of friction-reducing agent, and drive slowly for the first hour."

"Okay," agreed Radcliffe. "I'm glad I don't have to pay for a flywheel, because it looks like I'll have a wedding to pay for soon."

"In that case, you don't have to worry about how long this car's going to last."

"Why not?" asked Radcliffe.

"It'll last out this term," Gus assured him. "Then it'll be up to the Ghia." PS

Fiberglass sedan is Turkey's first car

The Anadol is the first car ever made in Turkey. The two-door five-seater uses a British Reliant engine, gearbox, and differential, but the body is made domestically and the entire vehicle is assembled in Istanbul. The Anadol costs $3,000, and 5,000 will be built this year.

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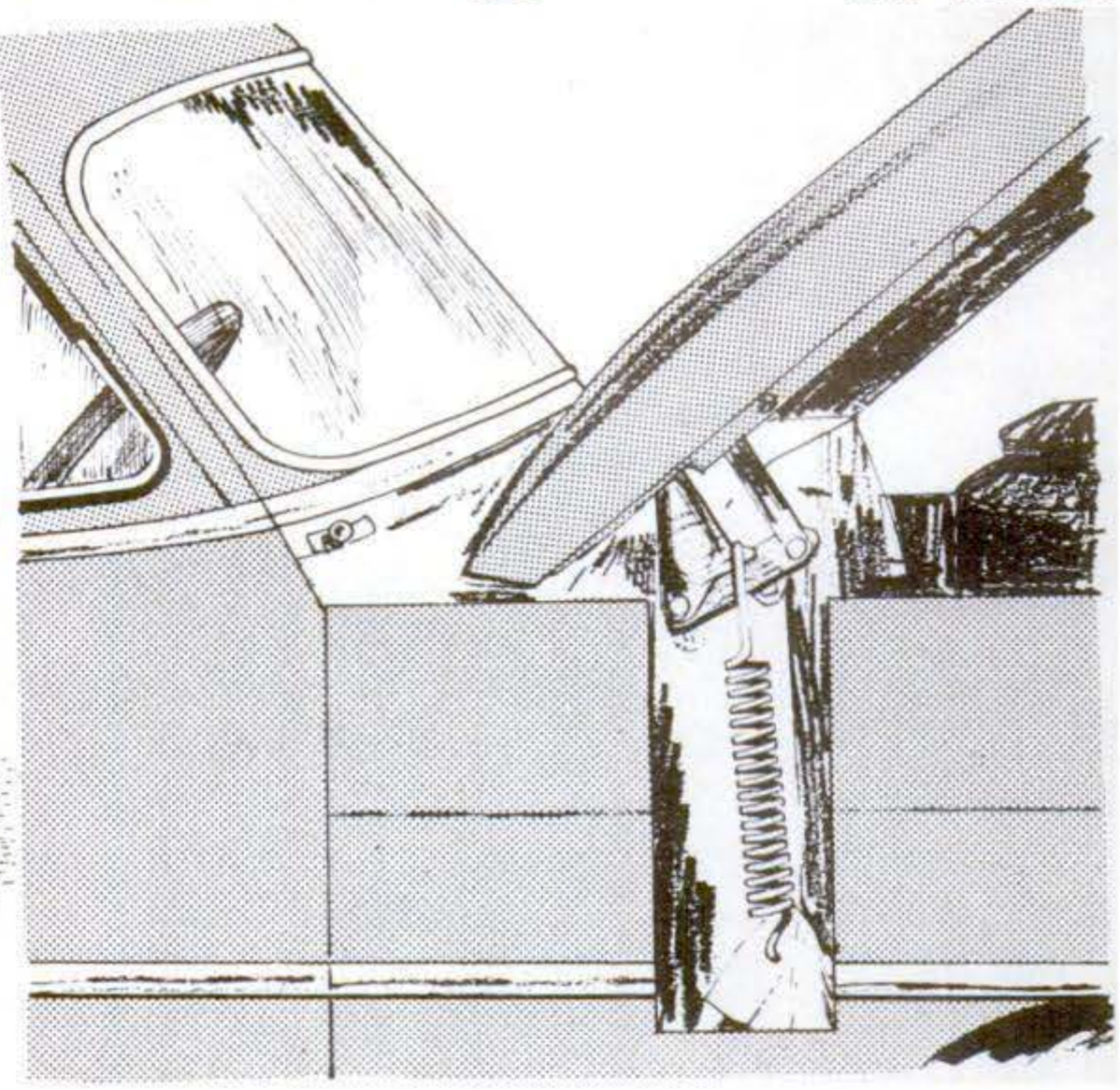
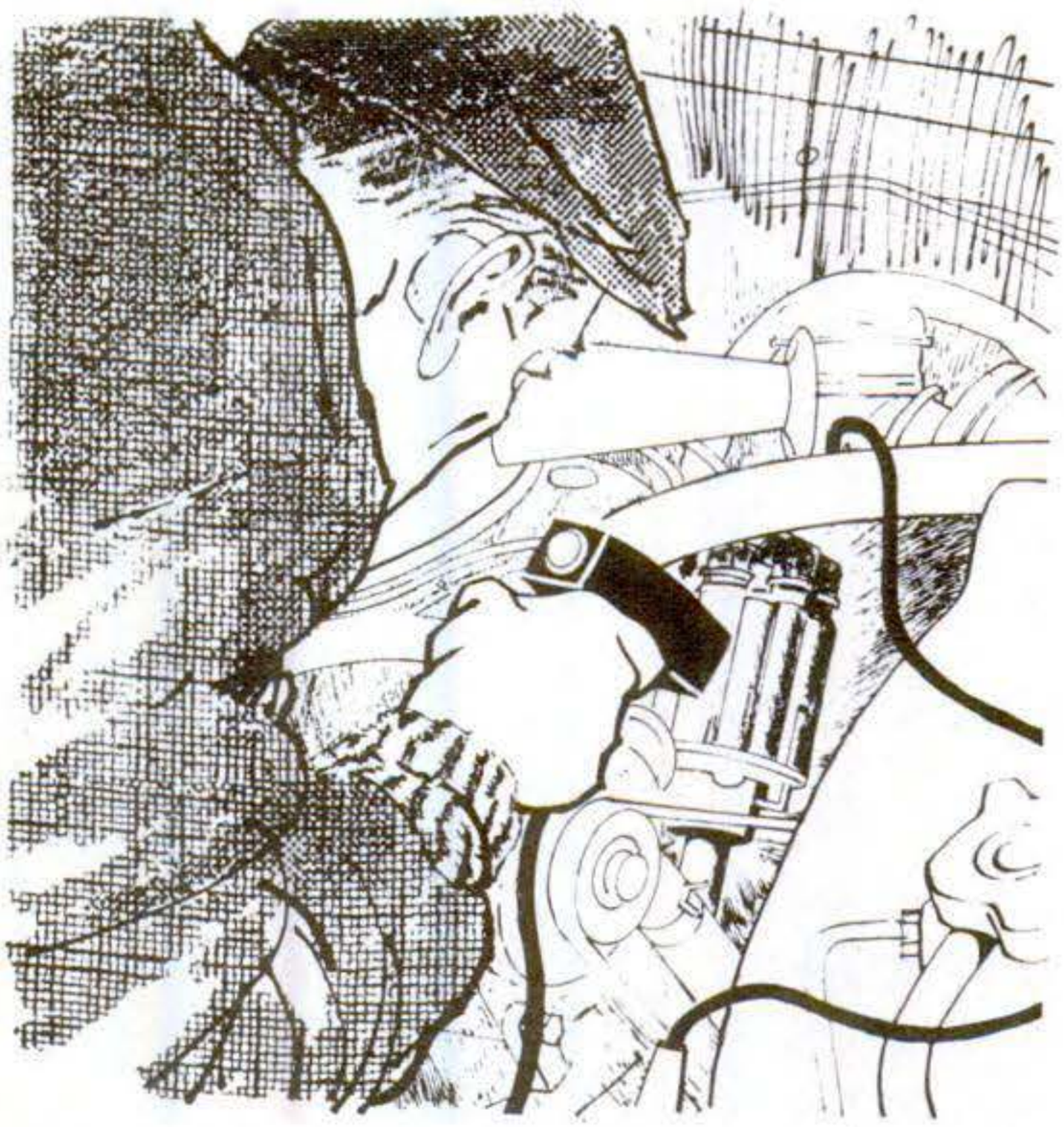
Hints from the Model Garage

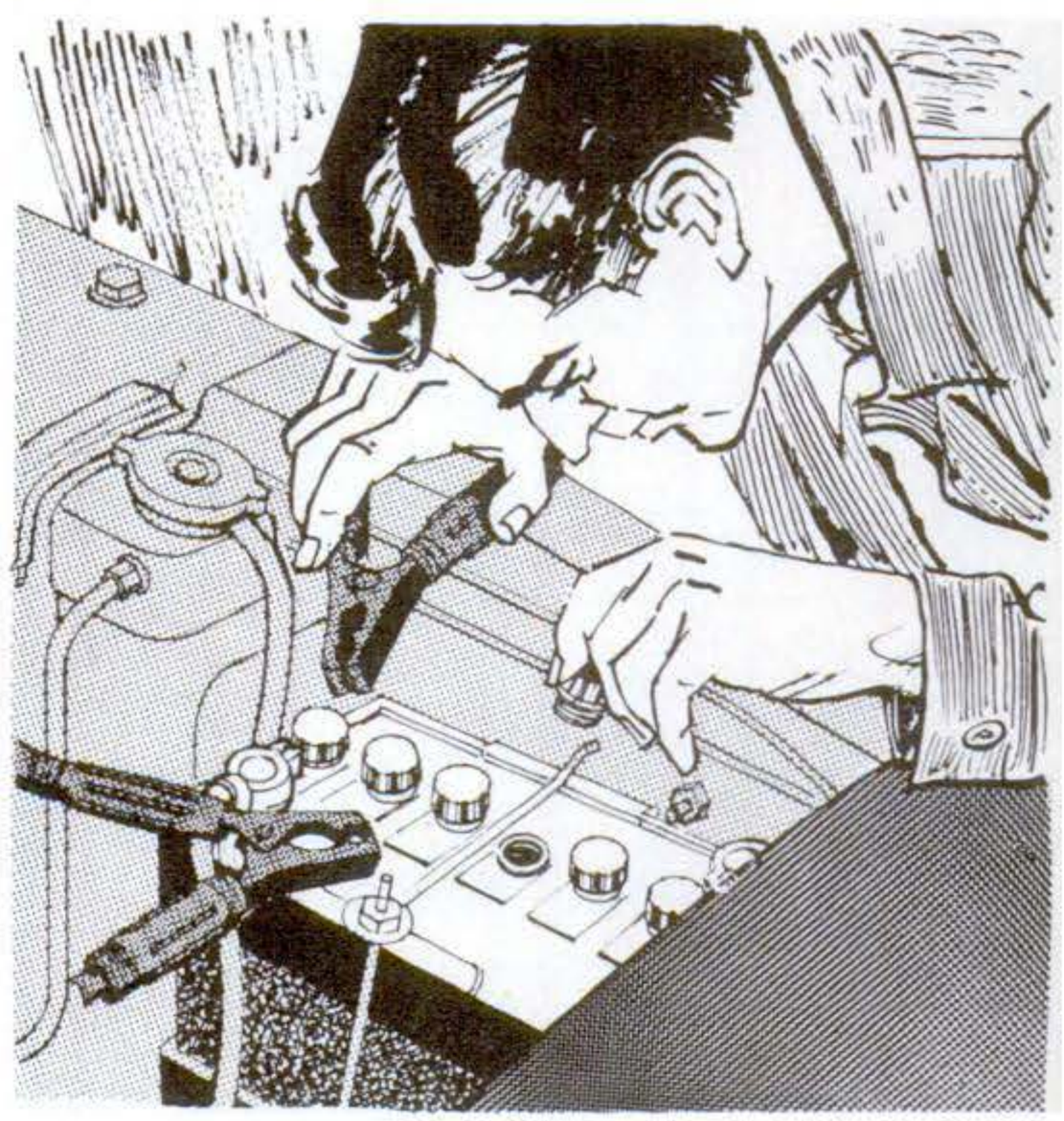
DRAWINGS BY RAY QUIGLEY



Hood counterpoise springs or brackets on Chevrolets from about 1952-55 can be fixed without special tools. The brace in the fender well is almost inaccessible, and the spring must be extended when fitted. Here's how: Measure the needed spring length for installation. Stretch the spring with a bumper jack. Wrap lower end of spring with freezer tape. Fill with water and place upright in deep freezer. After freezing, quickly release jack, hook lower end of spring on its brace, align the top end, and place the bolt in place. Allow the ice to melt.



You can check for oil leaks around moving parts with a timing light. Connect as usual, to the battery and to the No. 1 spark plug. The timing light will stop rotation and the motion of the part where you suspect a leak, and allow you to actually see the oil leaking.



Before recharging a run-down battery in cold weather, check for ice formation in the cells. The surge of electricity from a booster battery can blow up a battery with a frozen cell. If you suspect ice formation, set the car where ice will melt before you hook on the booster cables.

Continued

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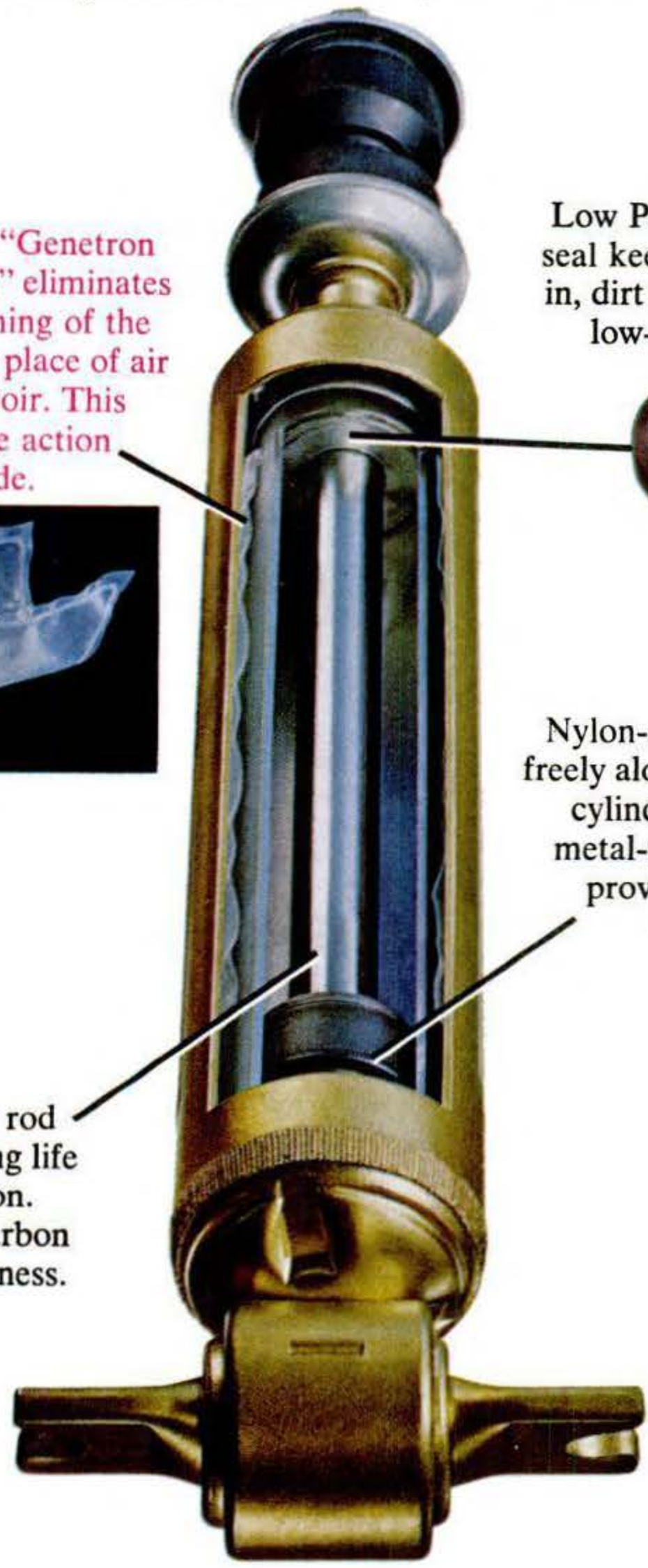

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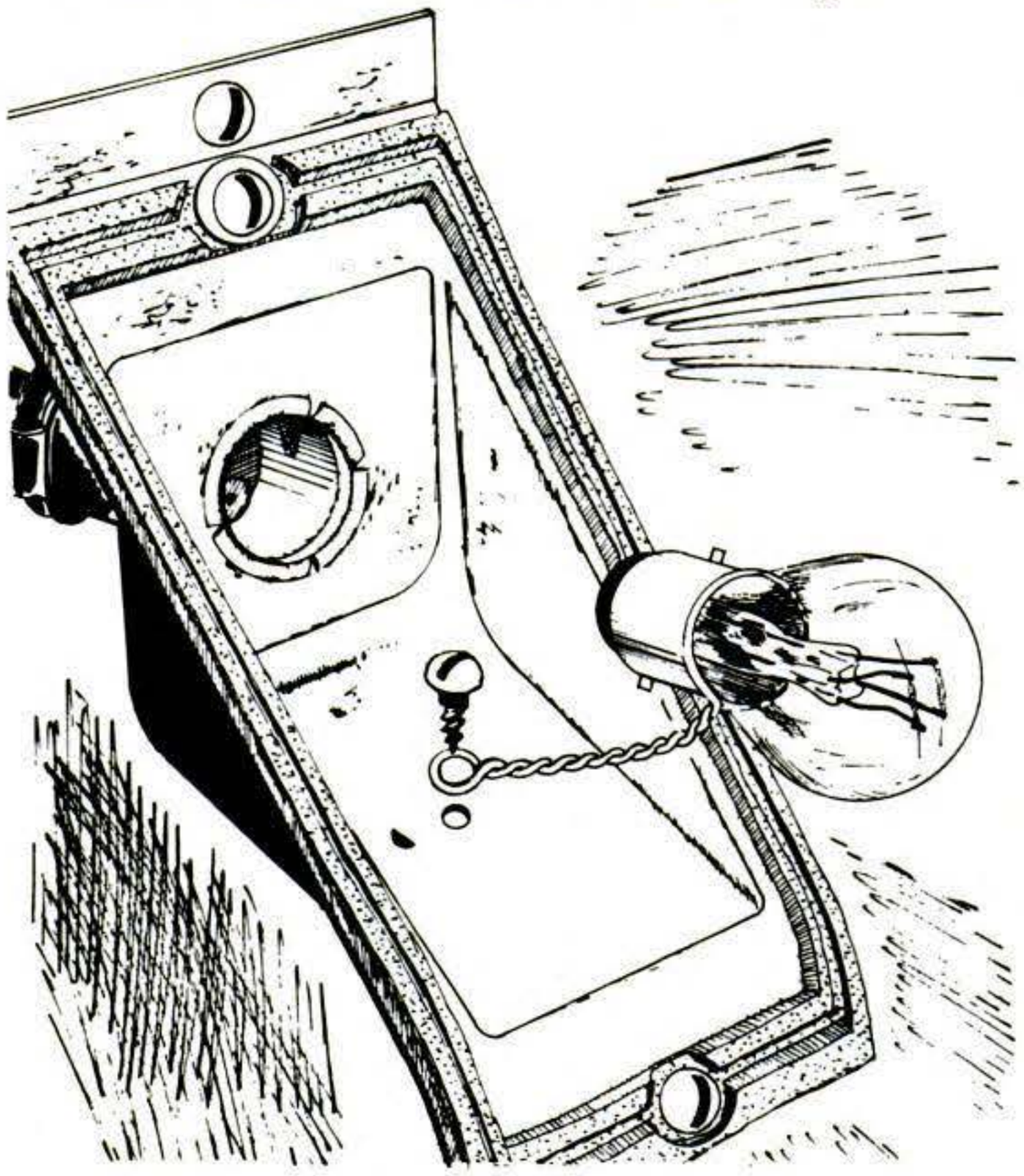
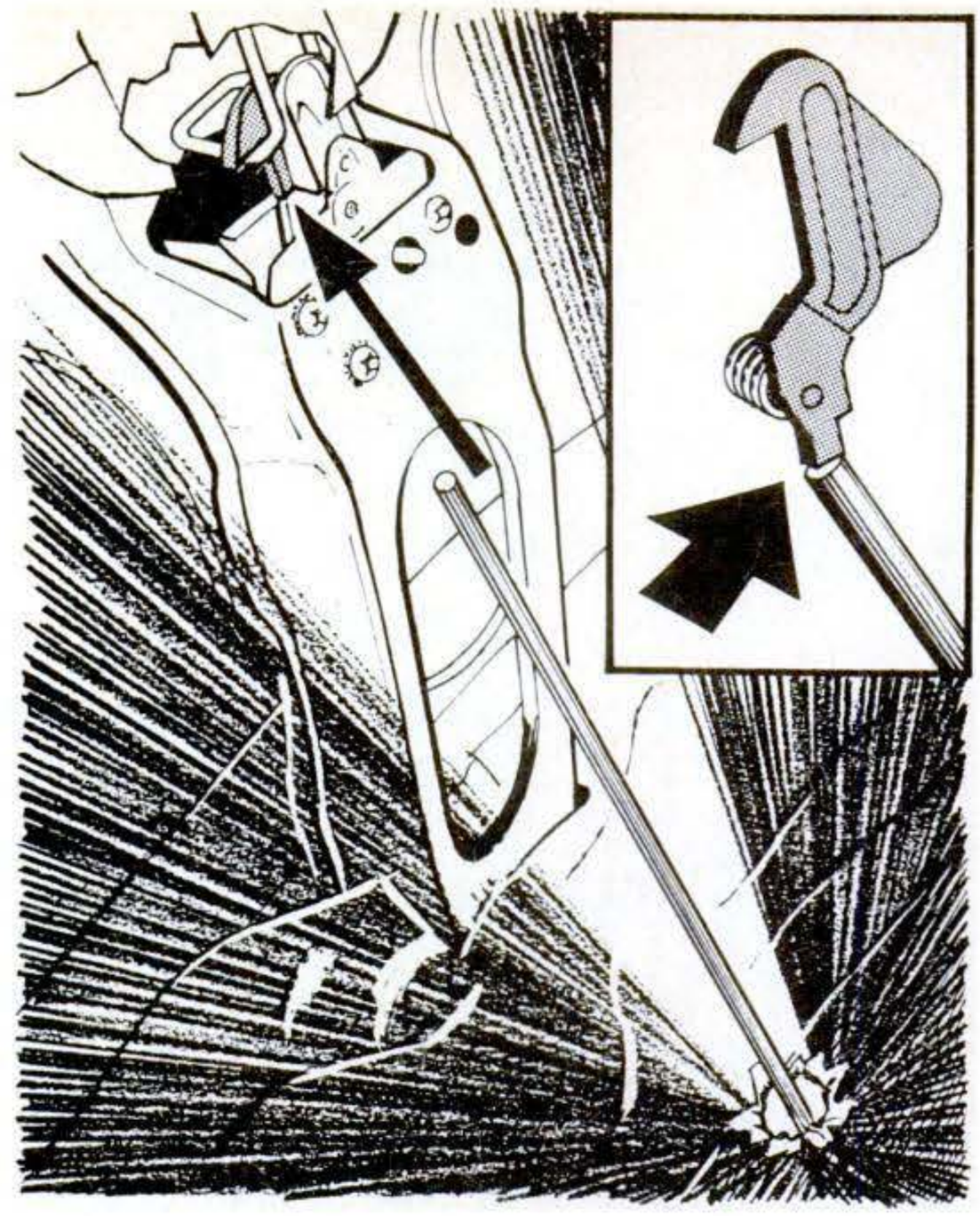
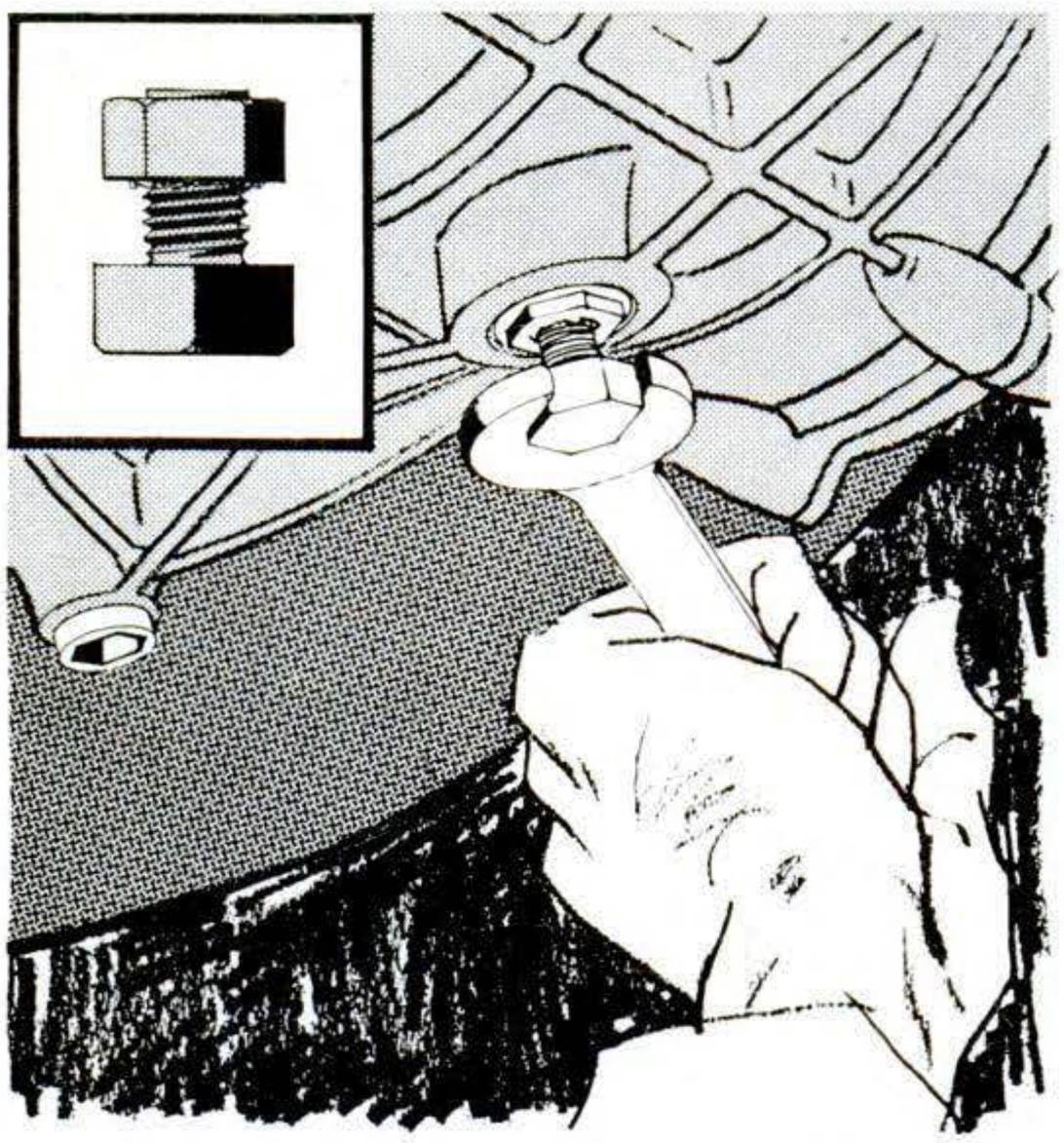
More Hints from the Model Garage



A corroded bulb socket on an older car can lose its ground. Get more life from it by cleaning it and wrapping a piece of bare wire around the brass base of the bulb. Solder the wire in place, and ground the other end of the wire to the lamp housing with a self-tapping screw.



Trunk lockout after body damage on a Corvair can be solved by working through the trunk drain hole. Pull out the rubber plug, cut a hole in the mat, shine a flashlight through the hole, and insert a rod against the retaining clip. An upward push will release the clip.



Removing the oil-pan drain plugs from 1960-'62 Volkswagens can be made easy with this simple tool. Weld an 11/16″ hex nut to the threaded end of a 1″-long ¾″ hex nut. Insert the smaller nut in the drain-plug recess and unscrew it with a regular open-end wrench.

Valve guides can be replaced in pre-'63 Chevy sixes by shrink-fitting them into the head. To hammer them in place could destroy them. Put the new guides in a deep freezer overnight, lift them out with needle-nose pliers, set them in place, and drive them in with a leather mallet.

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☐ Cortina GT rally stripes.

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☐ Room for five adults.
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☐ Wall-to-wall carpeting.
☐ All-vinyl interior.
☐ Ford's Model C is sold and

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☐ Take a test drive and watch your sports car senses come alive!
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Ford Cortina

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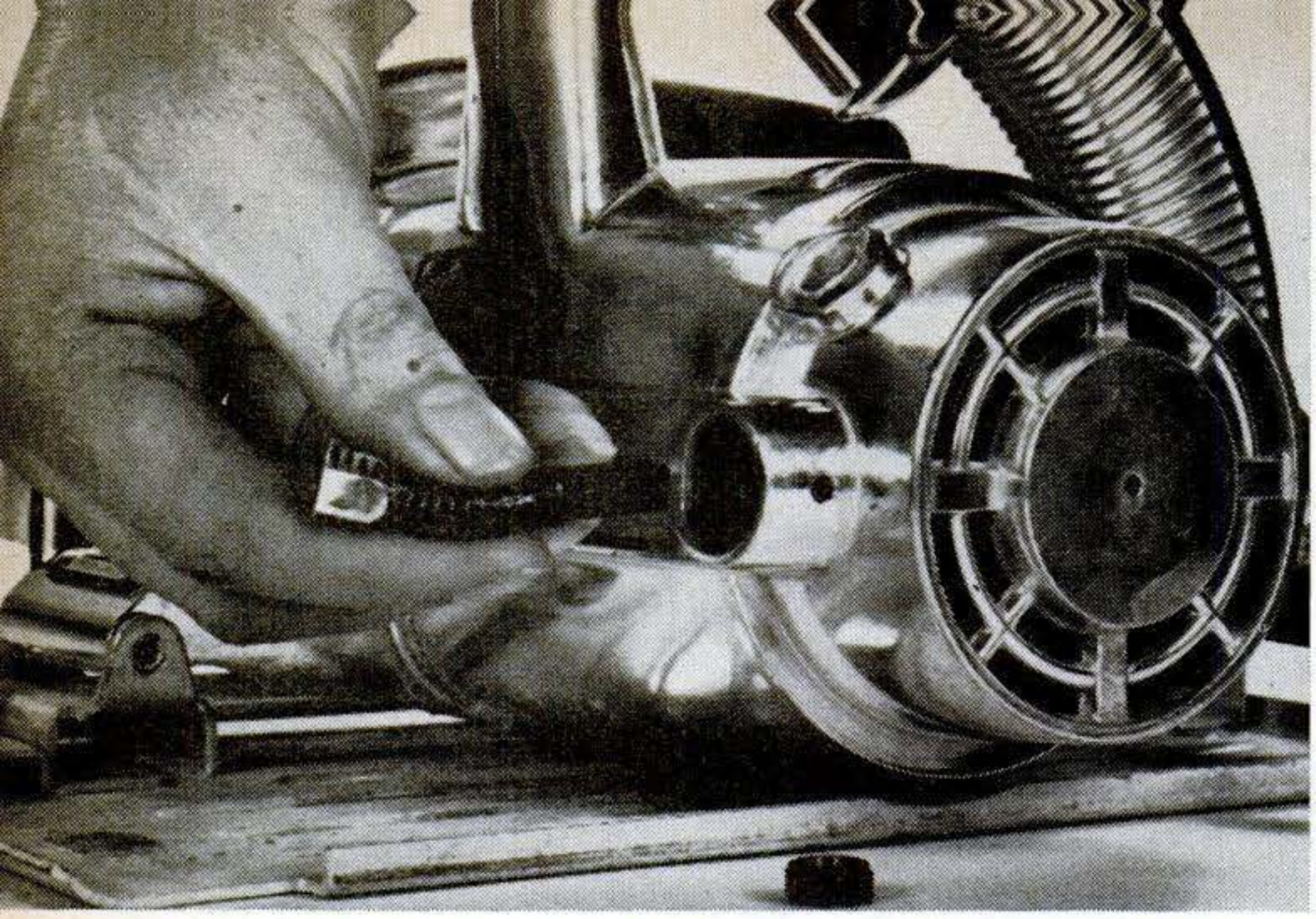
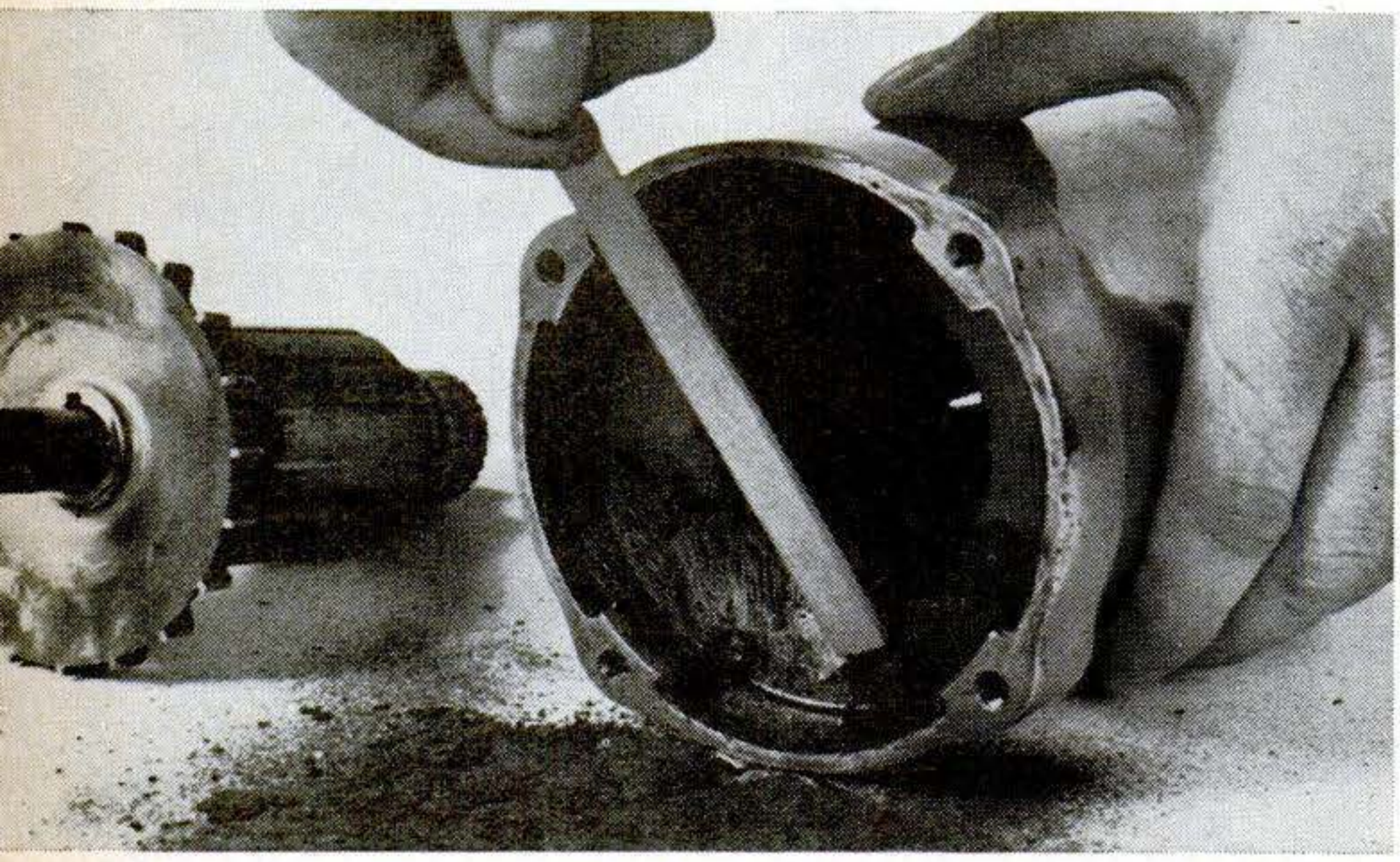
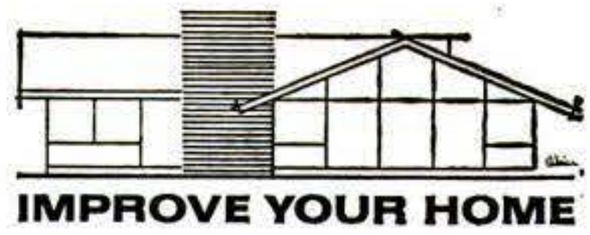


Check the carbon brushes of universal-motor tools periodically. When the brushes have worn down to half their original length, the brush-and-spring assemblies need replacement. Use manufacturer's replacements (the compositions vary) and always install new brushes in pairs.



A surprising quantity of caked dirt collects inside the casing of a universal-motor tool, particularly in the blower housing and around the brush holders. Heavy dirt deposits restrict the flow of cooling air. Scrape out dirt with a small stick; wipe casing clean with a dry rag. Don't use solvent.

Carbonized oily dirt between an armature's commutator segments can short the segments and blow a coil in the armature. If the surface of the mica insulation between segments looks black, scrape each strip of mica clean—until it's white—with a piece of hacksaw blade ground square.



How to Take Care of Your Home-Care Tools

By JOHN BURROUGHS

As a home owner, you need a good supply of tools to handle the repair and upkeep chores that come along. To get the most out of your tools, you must treat them with respect and take care of them.

Hand tools are no particular problem. Just don't abuse or misuse them. Keep cutting edges sharp. Store them so as to avoid rust.

When it comes to portable power tools, however, you're dealing with fairly complex electromechanical devices. Service engineers for companies that make these tools say lack of periodic preventive maintenance is one of two major causes of failure. The other is repeated and severe overloading.

Replacing burned-out armatures and field coils is the most common major repair job that manufacturer-franchised servicemen perform. That's a job that can run to half the tool's cost. So it pays to do all you can to avoid burnouts.

Continued

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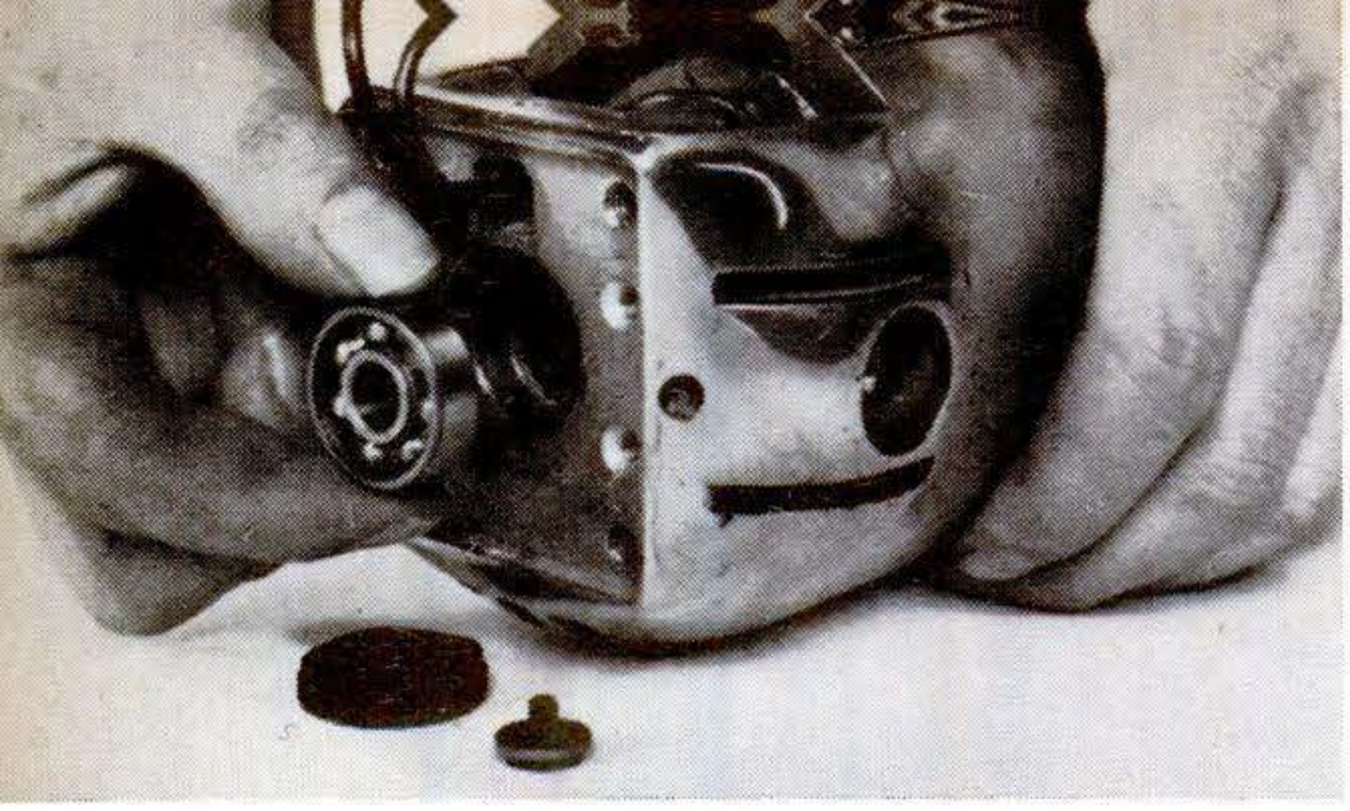
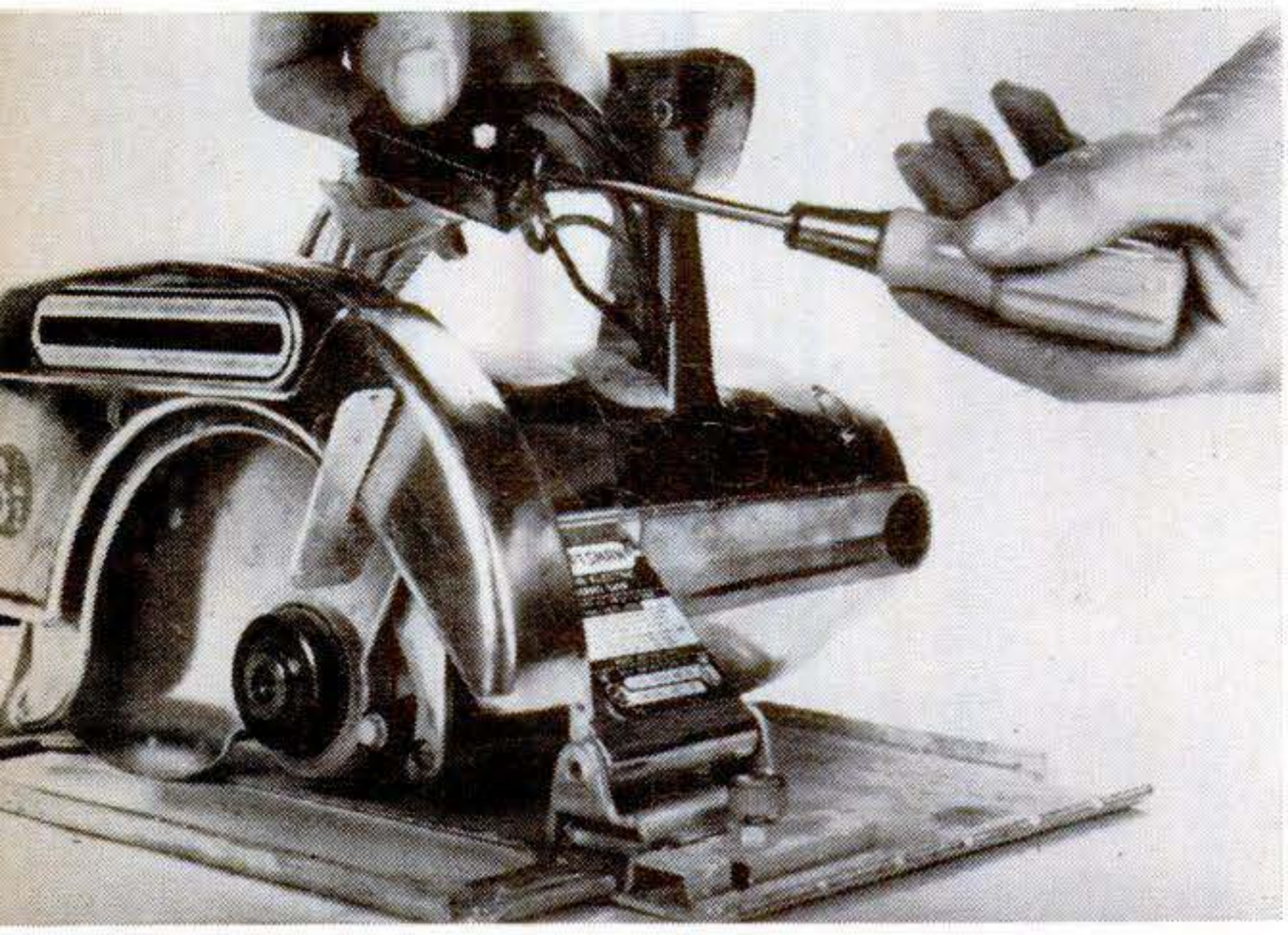


Rear armature bearings vary. Some portable tools have lubed-for-life ball bearings; many have plain or sealed-on-the-inner-side ball bearings; some have bronze sleeves. Open ball bearings should be relubed with special grease every two years. Sleeves need two drops of SAE 20 oil every three months.



Burned-out switches are a common trouble. While easy to install, replacement switches usually cost $3-$4. To prolong switch life, make it a practice to avoid switching a tool on or off when it's under load. When under load, the motor draws heavy amperage, and the heavy current burns switch contacts.

Preventive maintenance. Most manufacturers recommend that AC-DC tools be given routine checkups every 100 hours of operation. Ordinarily this inspection can be made without taking the tool apart. There are three things to check:

- Examine the commutator-and-brush assembly for wear.
- Look for dirt inside the housing.
- See that bearings and gears have adequate lubrication.

Mark the spring-loaded carbon brushes as you remove them for examination so you can replace them same-side-up. They should slide freely in their holders.

A set of brushes should last for some 500 hours of operation. They should be replaced when worn to half their original length. As brushes wear short, the force of the compression springs holding them against the commutator diminishes and they may begin to chatter. Because the composition of carbon brushes varies, use replacement parts supplied by the tool's manufacturer. Fit new brushes in pairs, shaping their ends to proper curvature with a strip of fine flint sandpaper wrapped around the commutator.

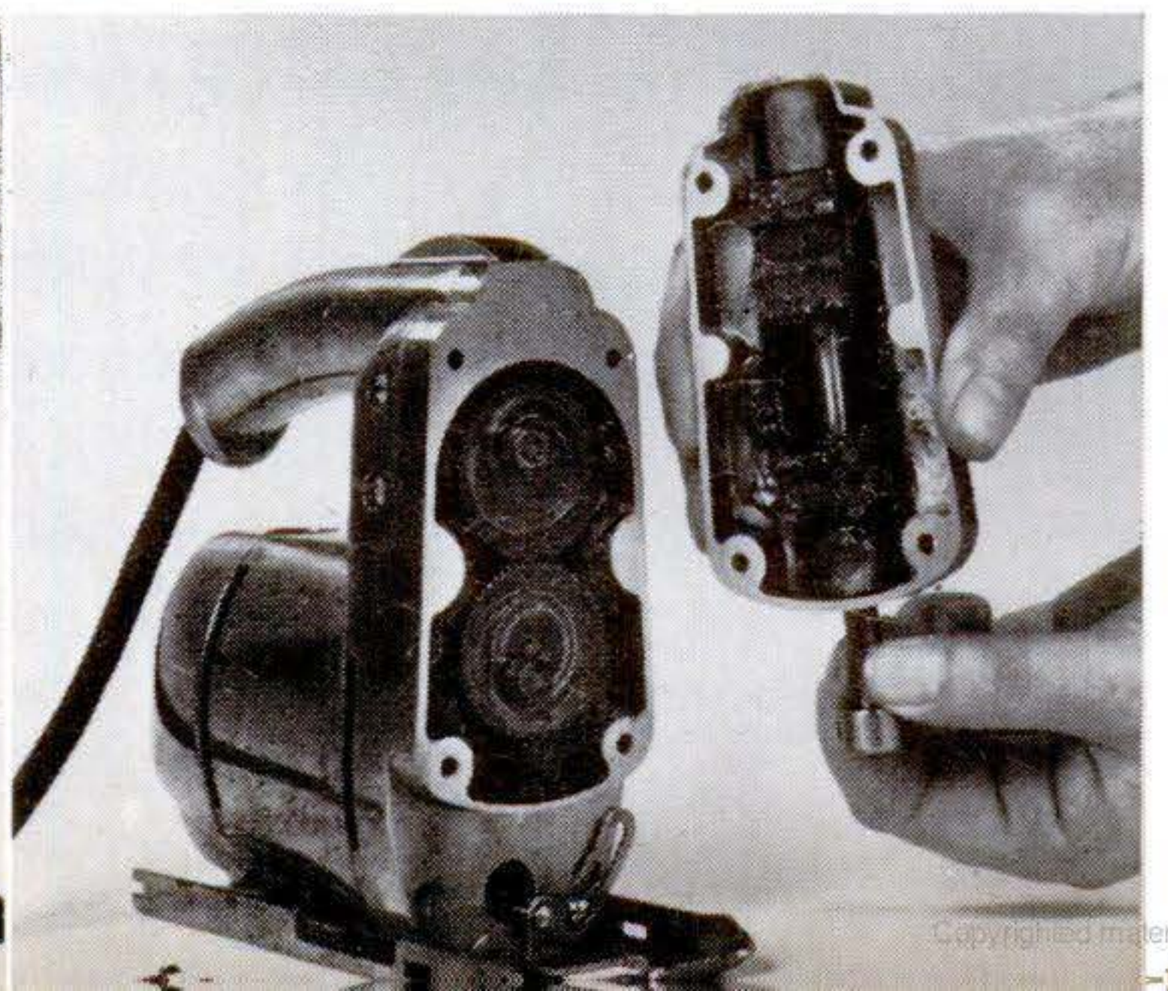
If the commutator is dirty, polish it lightly with very fine flint sandpaper folded over the end of a stick or with a special nonconductive abrasive stone. Don't use aluminum oxide or silicon carbide paper; conductive grit lodged between the commutator's copper segments can short the armature coils.

A commutator that is deeply grooved from brush wear should be lathe-turned

Continued

Gear cases of most portable tools (sealed, lifetime-lubed gear assemblies excepted) need relubing once a year. Wipe out old grease and refill the case half full with the special light grease recommended by the manufacturer. Gear-case greases are formulated to minimize separation of oil from the base.

Reciprocating-action tool has an eccentric-actuated shaft sliding in bronze bushings. To check the bushings for wear, grasp the sliding shaft and try to wiggle it sideways. Loose bushings in some reciprocating tools can easily be replaced. In others it's easier to replace the whole front assembly.



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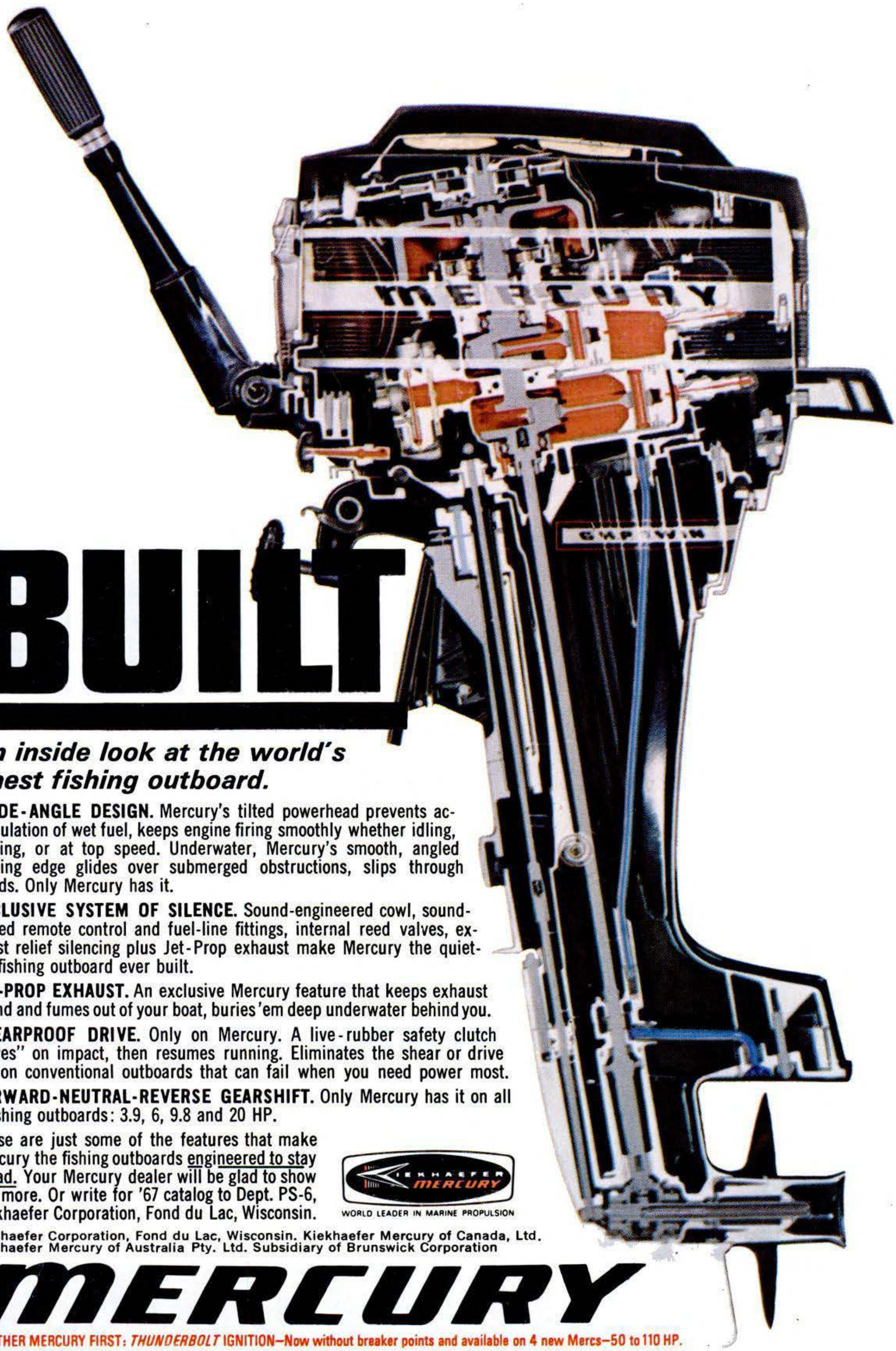

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true. Unless you have equipment to re-undercut the mica insulation between segments, have a service shop do the job.

When brushes are operating normally, you'll see characteristic steady blue sparking at the commutator. Excessive yellowish sparking (with power loss) indicates poor brush contact.

Dirt and dust. Dirt inside the casing is caused by the fan on the armature shaft, which sucks cooling air into the motor through rear ports and blows it out front ports. This air flow carries dust and dirt, which in time accumulate inside the casing, particularly around brush holders and in the blower housing.

Such deposits are doubly troublesome. They interfere with proper cooling by restricting the volume of air passing through the tool. And the dirt around brush holders can interfere with brush action and even short the brushes to the casing.

In industrial plants, portable tools are blown out with compressed air once a week to minimize dirt accumulation, but this is seldom practical in home shops. Home-shop tools should be taken apart and cleaned whenever inspection shows need.

If a tool needs lubrication, use only the lubricant the manufacturer recommends. Gear-case greases are specially formulated for best performance. Open-type high-speed ball bearings require a neutral soda-base grease (not ordinary calcium-soap cup grease, which has a low melting point).

Check your instruction booklet for proper lubricating intervals. Open-type ball bearings need regreasing every year or two. Sealed ball bearings should be replaced when they become noisy. Sleeve bearings require frequent oiling—two drops of SAE 20 oil every three months. Gear cases (except those lubed for the life of tool) should be refilled annually.

Avoiding overgreasing. If excess grease or oil inside the motor casing reaches the commutator, it will carburize and probably short the armature windings. Since grease expands as it warms, never fill a gear case or bearing race more than half full.

Home-shop tools are built to handle their rated loads intermittently. Be particularly cautious to avoid overheating the motor when you're using a light-duty tool with a high spindle speed—a small drill, high-speed disk sander, or circular saw. PS

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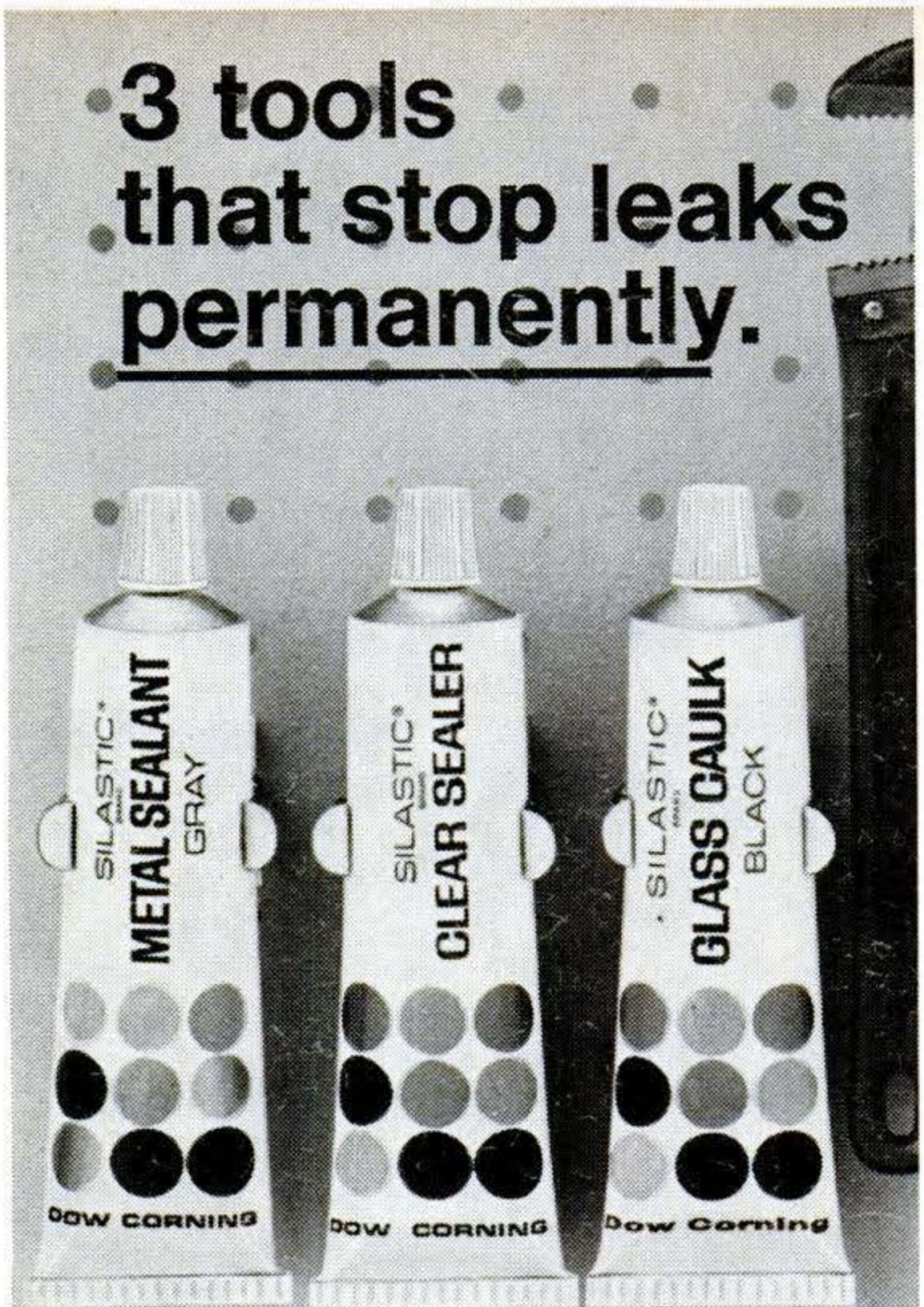

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Consumer Products Division
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Answers to Professor Miller's Questions

[Continued from page 120]

1. *The Car That Shows Why Planes Can Fly.* "The ball spins in the stream of air. (A spin is essential here.) When I tilted the airstream, the ball spun in such a way that pressure was reduced on its upper side. Thus the atmospheric pressure below kept it from falling. That's why an airplane wing gets its so-called lift, because the air velocity on the upper side, owing to the geometry of the wing, is higher (and the air pressure thus less) than on the lower."

2. *The Profound Physics of a Trivial Auto.* "Rubbing the car's rear wheels utilizes friction forces to put the wheels in motion. The rotational energy of the rear wheels, communicated by a gear to the flywheel, puts the flywheel in motion. There is now a large kinetic energy of rotation stored in the flywheel. That energy is now available to do work on the car, to move it."

3. *A Teddy Bear on Wheels Rolls Self Back Home.* "He rolls back because twist energy has been stored in the rubber fiber on which he is hinged. When the fiber untwists, it releases its stored energy and does work on the system by rolling the wheels in the opposite direction."

4. *A Rolling Wheel Is Enabled to Roll Straight Up.* "By imparting a motion by hand in phase with the position and motion of the wheel, I gave it enough kinetic energy of rotation and translation to enable it to work against gravitational forces. The reason it didn't fall off as it rounded the open end of the track is because its magnetized axle was conical. The magnetic binding force—we call it flux density—is greatest in that geometry."

5. *Rubber Pistol Proves to Be Loaded with Physics.* "The ball pops out because my squeeze further compressed the air inside the pistol and stored more spring energy in it. The greater the energy stored, the greater the velocity with which the ball is expelled. And the greater the velocity, the higher the pitch of the pop."

6. *An Instructive Performance of Dancing Devils.* "When I rub my fist across the upper surface of the box top, the friction gives rise to a negative electric charge on that surface and an opposite charge on the underside of that surface. The positive charge in turn gives rise to an electric field, which charges the little paper devils and causes them to leap up. Now, the lucite

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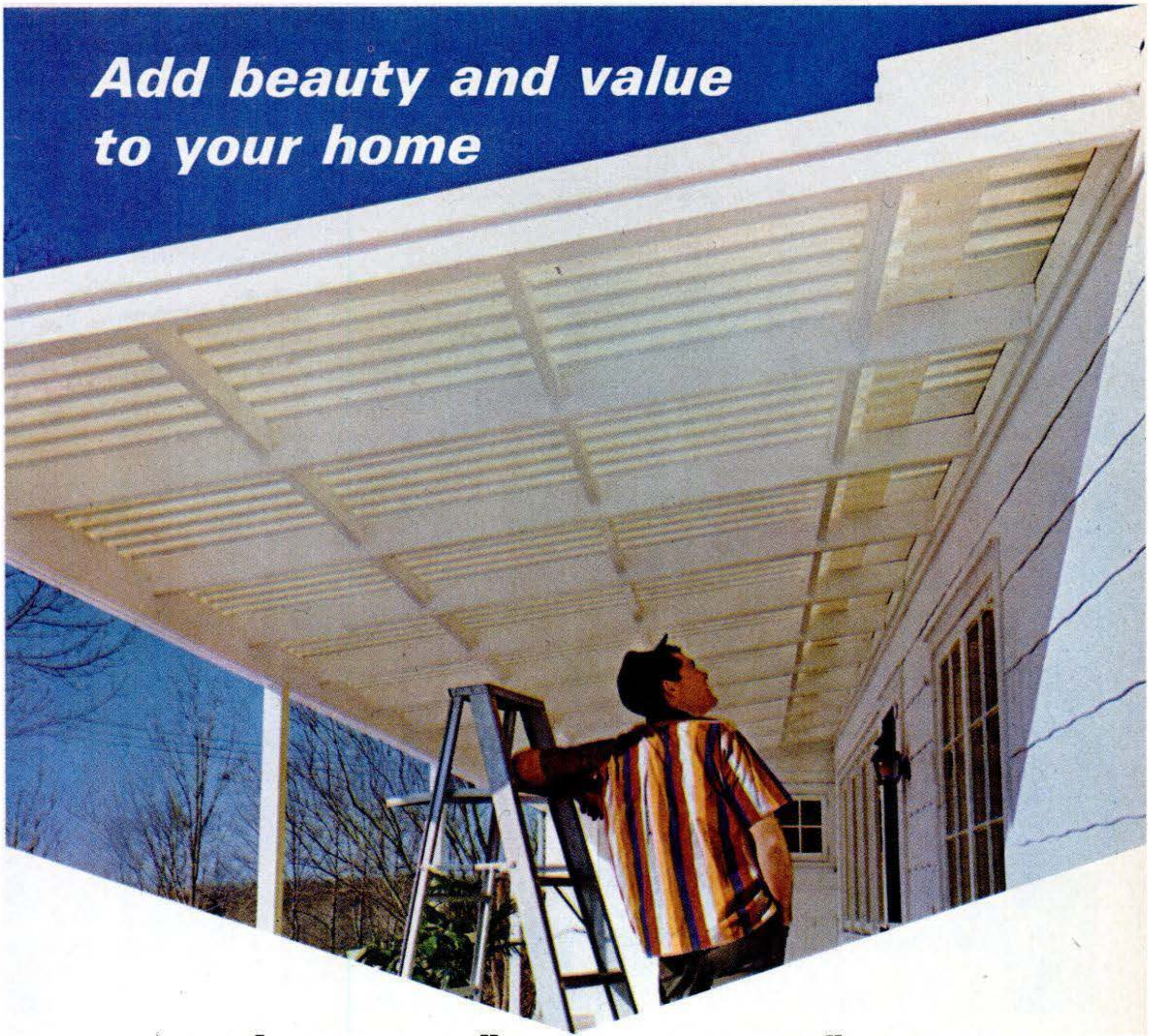

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Answers to Professor Miller's Questions

box top is a poor conductor, so the opposite electric charges on its outer and inner surfaces remain separated for quite a long time. When I put my finger on the outer surface, it neutralizes the charge at that spot, but elsewhere the original polarization remains fixed. That's why the little dancing devils jump away from my finger and are grabbed by the charge nearby."

7. *A Simple Demonstration of Jet Propulsion.* "In order to come out the rear of the chamber, the compressed air has to push on something, which is the front of the chamber on the inside. So the air comes out rearward with a certain momentum, and the chamber moves forward with an equal and opposite momentum. That's how jet propulsion works. Note: The stuff coming out does *not* push against the atmosphere!"

8. *A Pint-Size Monocyclist Defies Gravity.* "The balls on the ends of those sticks are very heavy compared with the monocyclist's weight, so I've lowered his center of gravity to a point below the bottom of his wheel. At the same time, those outstretched sticks have greatly increased his moment of inertia, so he doesn't tip so easily. That's why you can balance a chair by a leg on one finger."

9. *This Walking Dog Knows When to Stop.* "While he was some distance from the edge, the force pulling him was horizontal. When he got close to the edge, the pull in the string was vertical—and no vertical force has a component in the horizontal, so he could go no farther." PS

Lunchbox has built-in food heater

Fed up with cold lunches? This new aluminum lunchbox has a built-in heating unit that warms everything—soups, sandwiches, maybe even nuts. The Thermette is made by Privett Mfg. Co., 1201 48th Ave., Oakland, Calif. You can own one for $14.50.

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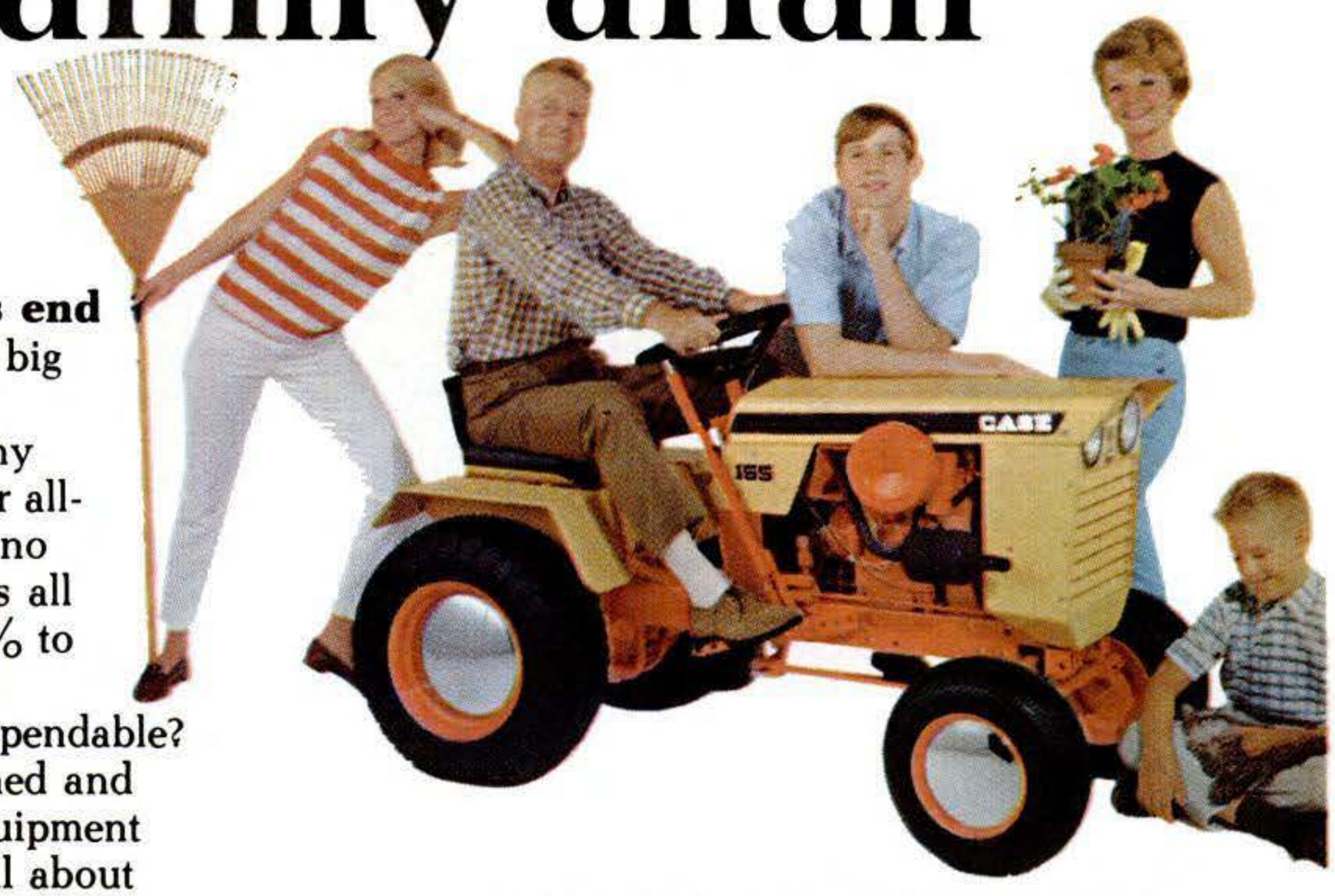

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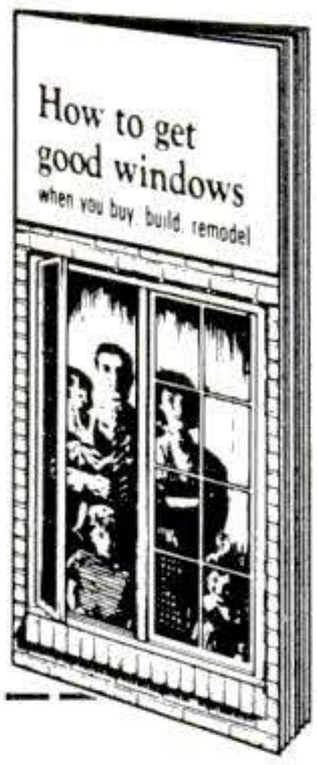

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Worthless Health Aids

[*Continued from page 93*]

enge manufacturers who'd been promoting their trochees as useful against this most common of all diseases were recently told to recall their products or face federal action—the lozenges had no effect at all.

"An inexpensive blood test by your doctor will show whether you need iron medicine for 'tired blood.' Most people don't. Symptoms of tiredness can be due to many different causes, but a layman can't tell whether his tiredness is caused by iron deficiency or by some other, perhaps very serious, condition. Pernicious anemia, for example, is a fatal disease if not treated properly. Self-treatment should never be attempted. Such remedies actually may mask symptoms of diseases, of which anemia is one."

Are so-called "nerve tonics" worthwhile medicines? Goddard feels that these drugs —mild sedatives containing bromide—are no longer the problem they used to be years ago. Nevertheless, the FDA maintains a strict watch over the labeling of such compounds to insure that they are not recommended for serious illnesses.

Case of the Laxative Liver Pills

How does the FDA feel about so-called "liver pills" and other digestive aids? Some years ago, after the Federal Trade Commission instituted a proceeding, the manufacturer of "Carter's Little Liver Pills" removed the word "liver" from the brand name. Now, other pills will come under FDA scrutiny. These are composed partly or solely of dried liver, and contain vitamin B12 or other vitamins, minerals found in liver, and whatever other ingredients the manufacturer adds.

The FDA is, of course, also responsible for the wholesomeness, safety, and labeling of all foods and drugs—"digestive aids" and "antacids" included.

Does Dr. Goddard seriously expect to be able to curb the American public's compulsion to buy and use worthless health aids?

"We are attempting to place the facts about dietary supplements and special diet foods before the American people," says Dr. Goddard. "We want to curb false information about products, which is our responsibility under the law. What people do in response to the facts made available is a matter for their own judgment." PS

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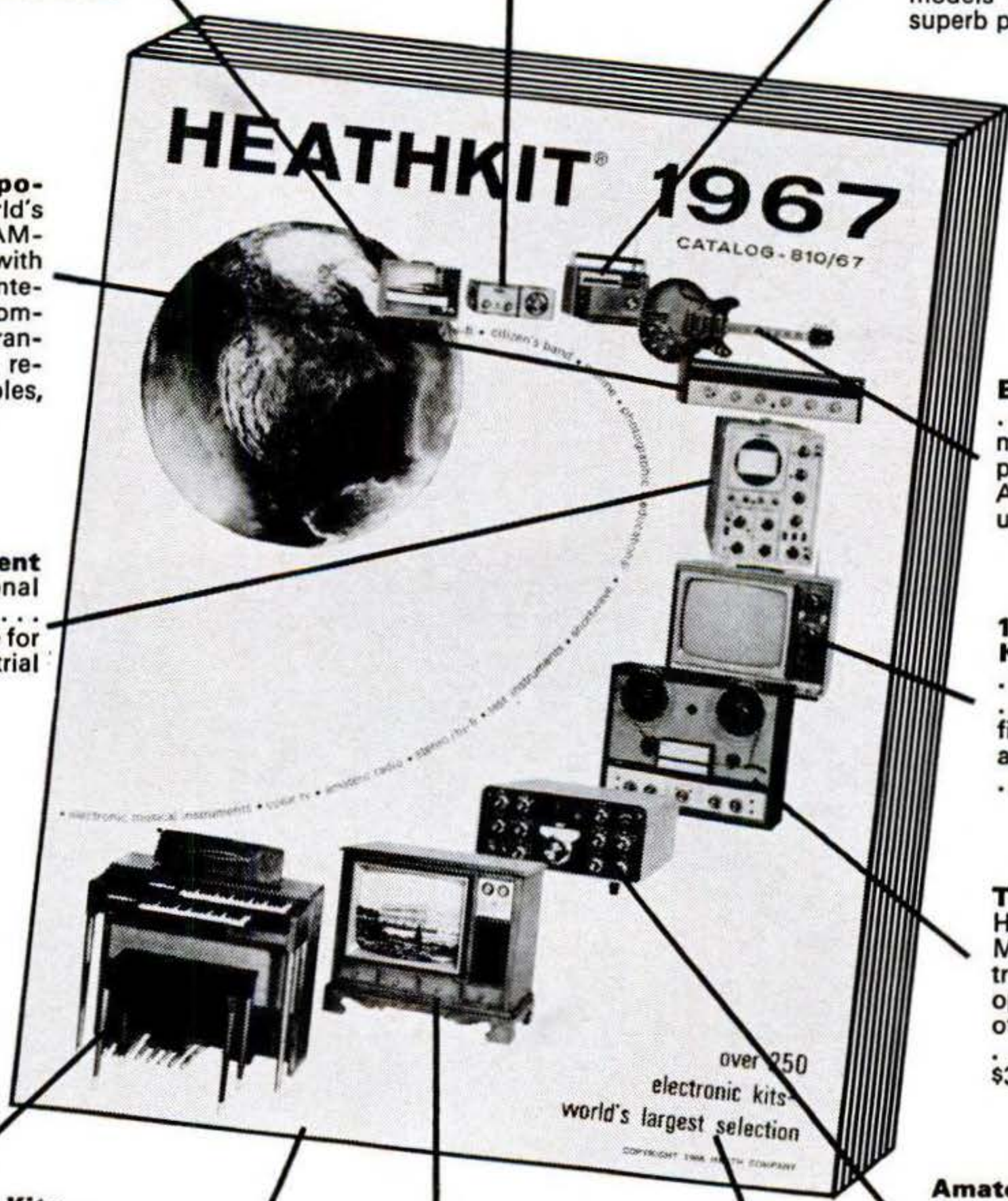

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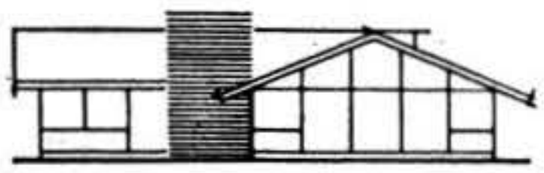

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(Continued on page 224)

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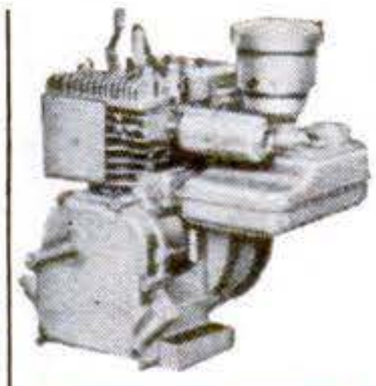

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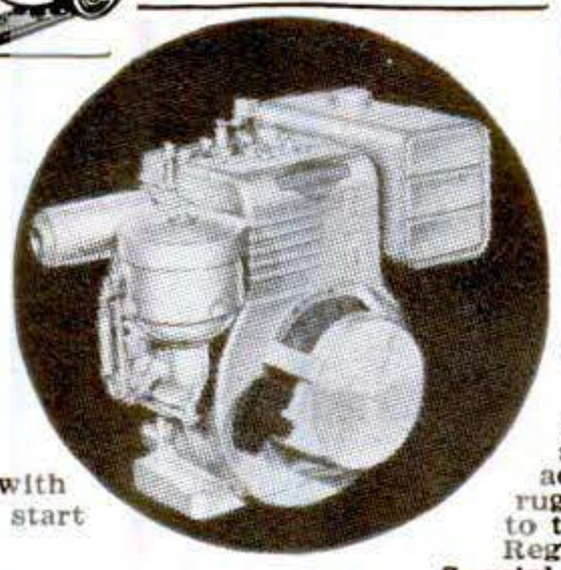

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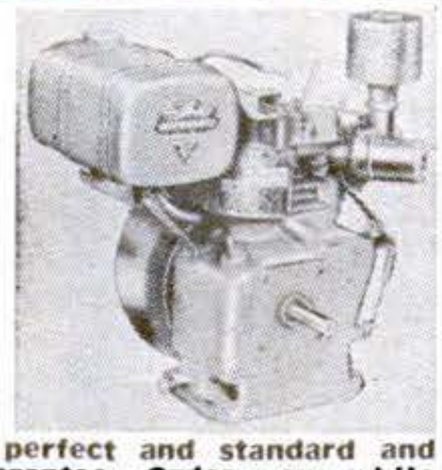

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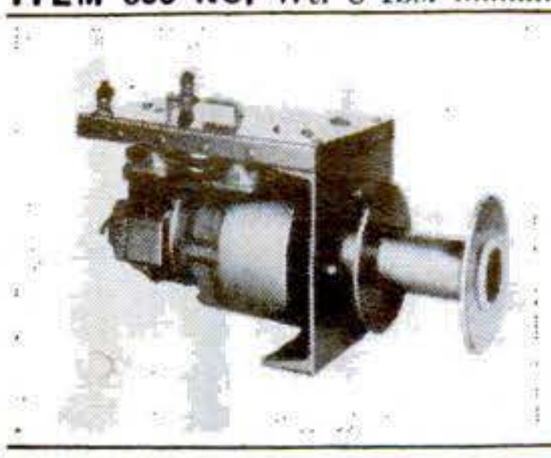

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A Summary of Riding Mowers

[*Continued from page 147*]

Homelite. Compact design in a 26" rider with good from-the-seat availability of controls. Variety of lawn-care attachments.

Homko. A range of four riders from a 24", 5-hp. rotary to 30", 7 hp. The main line of rotaries features suspension of the engine and housing on a steel-tube frame on which the wheels are mounted. Single lever raises and lowers engine-housing unit to change cutting height. A 24", 5-hp. rider is only one with engine in front. Orbit Disc drive on 7-hp. rider.

Huffy. (Huffman Mfg. Co., Box 1036-T, Dayton, Ohio.) Riders from 3½ hp. to five hp., with 24" and 25" cut. Bigger riders have wind-up height adjustments, differential.

Jacobsen. Line of rider rotaries with matched accessories; also a big 26" front-throw reel that can pull a riding sulky.

Lambert. (520 Hunter Ave., Dayton, Ohio.) A big rider with a 32" pan and three-point suspension. (This is virtually the same machine as sold under the name of Hunter.)

Lawn-Bird. (Sullivan, Ill.) Rider with 5- or 6-hp. engines, 30" or 32" cut. One of several using a transaxle with H gearshift. Tote box back of seat for extra carrying capacity.

Lawn Boy. Outboard Marine has just introduced a new 6-hp. rotary rider with a 30" cut.

Locke. Two riders, 24" and 32", are made under the Devere-Locke name, and sulkies are available for the other large mowers.

Montgomery Ward. Five variations in rear-mount, mid-mount, or front-mount engines, in a range from 3 to 6 hp.

Moto-Mower. Two 24" riders, one with 4-hp. engine, one with 5-hp. The former has a two-speed transmission, the latter four. Both have recoil starters. Big one has tractor-type hood.

MTD Lawn Flite. (MTD Products, 5389 W. 130 St., Cleveland, Ohio.) Five riders. One, a stripped down model, has a 3½-hp. engine.

Pennsylvania. A riding mower, with engine in back of operator, takes a belly-mounted rotary or a reel. Chute guard in the form of a heavy coil spring blocks a foot or a hand from reaching the blade.

Reo. Line of riders. Single-lever height adjustment. Deadman feature. Impulse starter. (Did you know that Reo and Wheel Horse have joined forces?)

Roof. (Roof Mfg. Co., Pontiac, Ill.) This high-wheeler specialist has a high-wheel rider, in addition to sulky attachments for the others.

Root. (Baxter Springs, Kans.) Riders of 5, 6, and 8 hp., the smallest a tricycle model with single steering wheel in front.

Sears. A line of four riders, beginning with the economy 3½-hp. minimum rider. Others at 4 hp. and 5 hp., with 24" cut, and a 6-hp. machine with 26" cut. A grass catcher, with outrider wheel, is available for the top riders.

Continued

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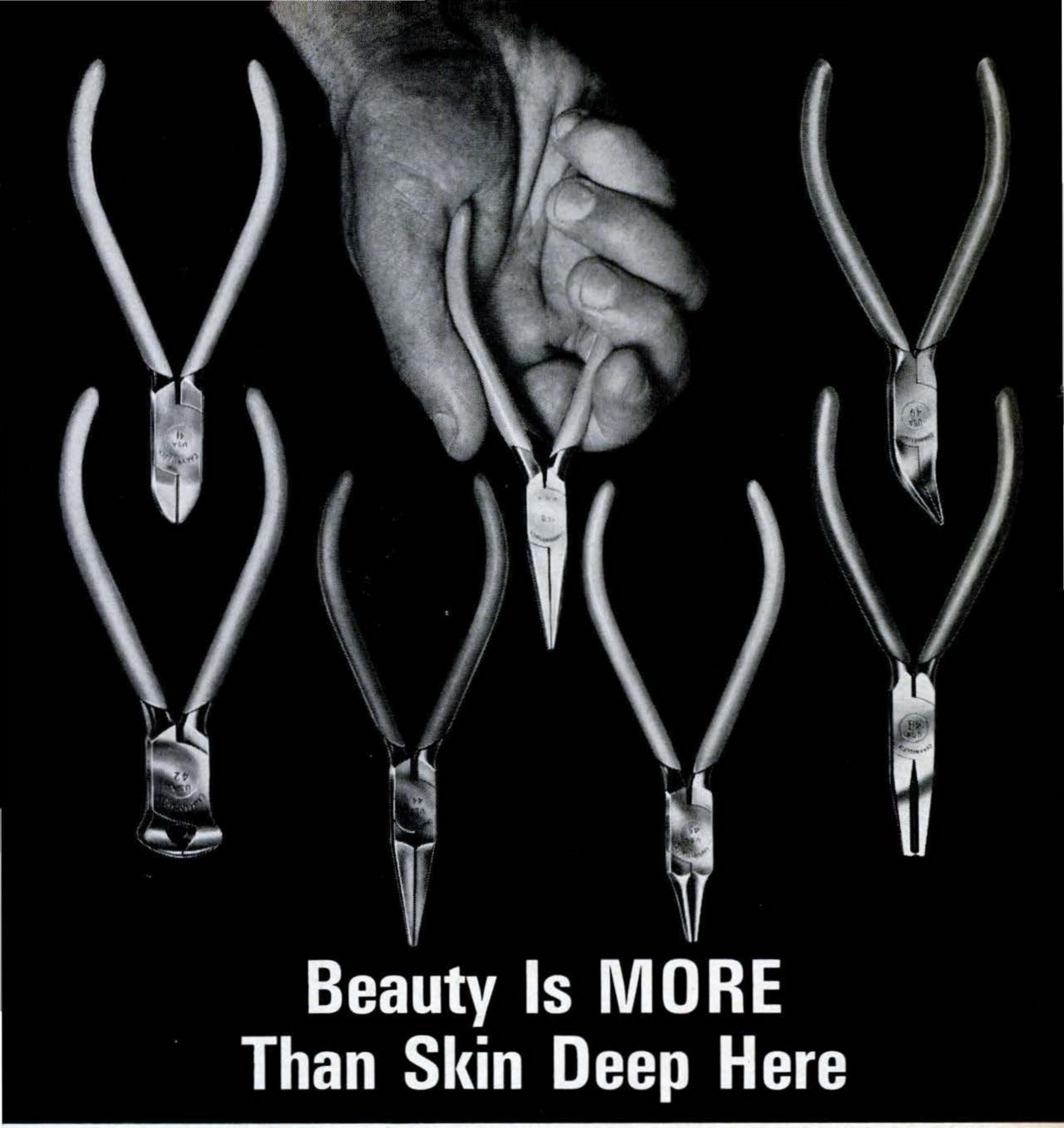

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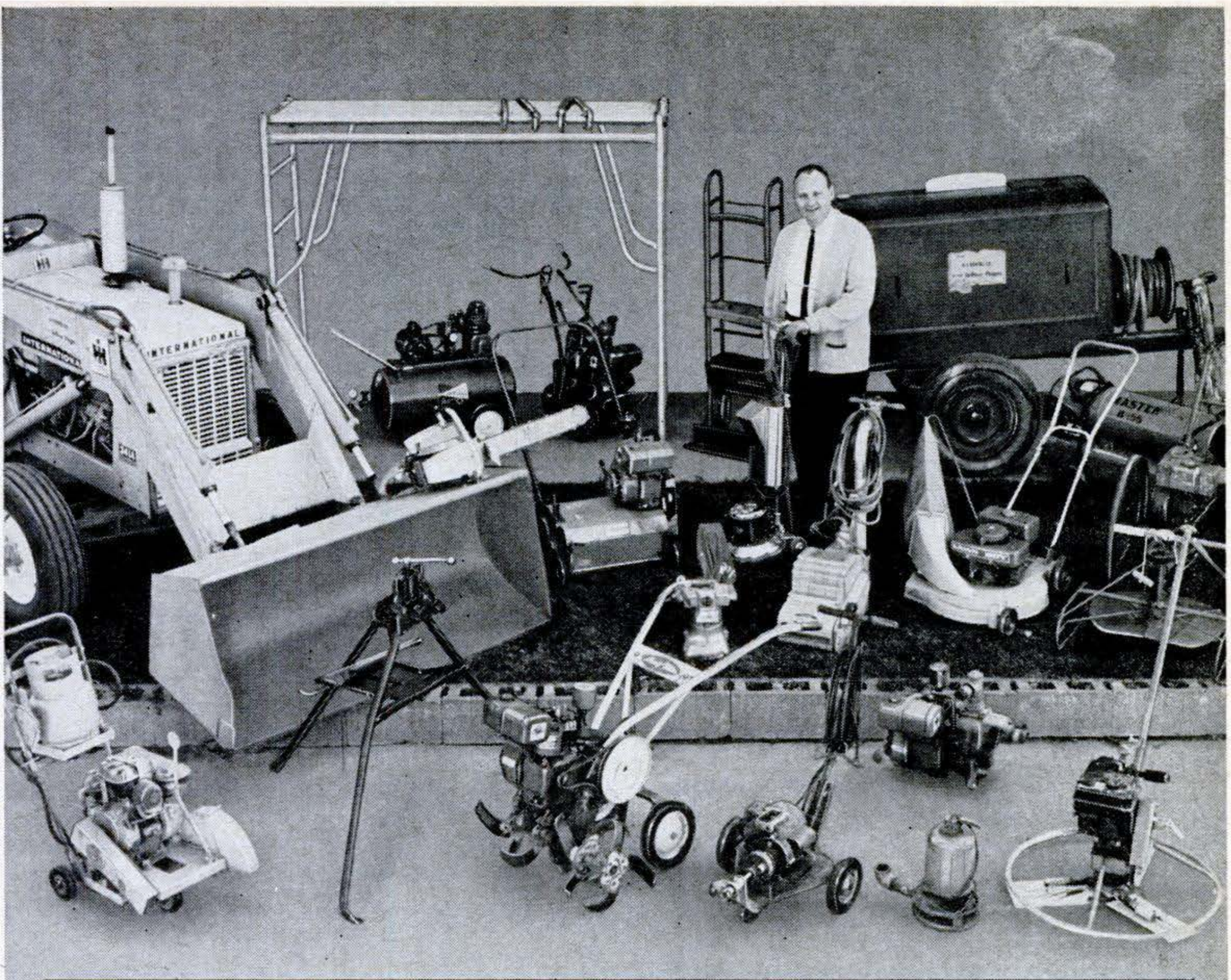

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A Summary of Riding Mowers

Simplicity. Five riders, ranging from a full-scale tractor down to a new 24" model with rear-mounted 4-hp. engine in the company's Wonder-Boy series. Floating power mounting permits the mowers to follow lawn contours.

Sunbeam. Long a specialist in electric mowers, Sunbeam now offers a full line of gasoline-powered mowers, including three 25"-cut riders of 4 hp., 5 hp., and 6 hp., as well as an 8-hp. tractor.

Toro. The Toro line has been expanded since the company acquired Quick Mfg. Co., builder of the Springfield tractor. Rotary riders include tractor-styled 4-, 5-, and 7-hp. machines, a 5-hp. reel with 58" cut, and the 6-hp. rear-engine long-reach style in two sizes.

Yard-Man. Line of riders. A feature is a rugged four-wheel pusher that takes, out front, either a reel or twin-blade rotary.

A Summary of Home Tractors

[*Continued from page 151*]

tandem transmission as an accessory gives nine speeds forward, three reverse; individual rear brakes.

Gilson. Hp.: 10, 8, two 6s. Drive: transaxle with torque-drive shaft; three or four speeds; brake-clutch. Accessories: rotary, gang reel, dozer, snowblower, cultivating line. Features: ball-joint steering tie rods, 36" turning radius; lever-lift for attachments.

International. Hp.: two 12s, 10, 7. Drive: hydro on one 12; standard Cub direct drive on others, with three H-shift forward speeds, one reverse. Accessories: full line, including front-end loader, heavy-duty sprayer, lawn vacuum, sweeper, carryall body. Features: tool hoist; single- or three-point hitch.

Jacobsen. Hp.: two 12s, two 10s, 8. Drive: hydro on a 12 and a 10; gears on the 8, other 10 and 12. Accessories: full line. Features: wheels convert to wide track for extra stability; low lugging gear on nonhydro models; hand-power lift of attachments; PTO.

Lambert. Hp.: 10, 7. Drive: belt-gear-chain three speeds forward, one reverse. Accessories: standard line. Features: differential; gear and pinion steering; cigaret lighter; horn.

Magna. Hp.: 9, 7¼. Drive: transaxle, cone clutch. Accessories: blower, mower, dozer disk, harrow, plow, power tiller, cart, roller Features: extendable rear wheels.

Massey-Ferguson. Hp.: 12. Drive: hydro Accessories: full line of 30. Features: worm gear steering; adjustable seat; toolbox.

Minneapolis-Moline. Hp.: 10, 8. Drive: automotive-type transmission with differential built in. Accessories: all. Features: small-radius steering; hand-lift hoist, hydraulic available.

Montgomery Ward. Hp.: 12, 10, 8. Drive automobile-type transmission with stick shift speeds from about ½ m.p.h. to 5. Accesso

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A Summary of Home Tractors

ries: full line. Features: crankshaft balancing; pilot light signal on PTO; pin-on attachments.

Moto-Mower. Hp.: 10, 8, 6. Drive: transaxle, three forward, one reverse; up to six m.p.h. Accessories: 22, scaled for different powers.

Economy's 12-hp. Jim Dandy above comes with dual tires for more traction and less dig-in on lawns.

Features: implement control lever; 23" and 16" wheels; headlights on 10.

MTD. Hp.: 7. Drive: direct to transaxle; three speeds forward, two reverse; six m.p.h. top. Accessories: mower, snow blade, trailer. Features: clutch-brake; 48" turn radius; six-position tool-lift lever.

Pennsylvania. Hp.: 12, 10, 8, 7. Drive: hydro on 12 and 10, single-lever shift on 8 and 7. Accessories: full range of 35 operations. Features: independent rear-wheel brakes for tight turns; easy-spin; automotive-type differential.

Sears, Roebuck. Hp.: 12, 10, 6. Drive: gear transmission, six speeds forward, two reverse; four and one on the 6. Accessories: more than 20. Features: easy attachment of accessories requiring power; rear wheels adjustable for width; auto steering on 32" radius.

Simplicity. Hp.: two 12s, two 10s, three 7s, an 8 in a two-wheeler. Drive: gearshift; three speeds forward, one reverse, or six speeds with auxiliary power converter. Accessories: full-range scaled to tractor size, including sickle bar and heavy-duty weed cutter. Features: easy-pull; counterbalanced engine; three-point PTO; controlled traction differential.

Toro. Hp.: 12, 10, 8, 7. Drive: automotive transmission with differential; four speeds forward and reverse on 10 and 12, three speeds and reverse on 7 and 8. Accessories: 12 of the standard varieties. Features: 27" turning radius; front PTO; easy-pull starting; easy-on-off attachments with height lever.

Wheel Horse. Hp.: 12, two 10s, two 8s, two 6s. Drive: choice of gear or hydro in upper powers. Accessories: full range, depending on power. Features: side-stick hydro control; combination clutch-brake pedal.

Note: Where manufacturer's address is not given, check the Yellow Pages. PS

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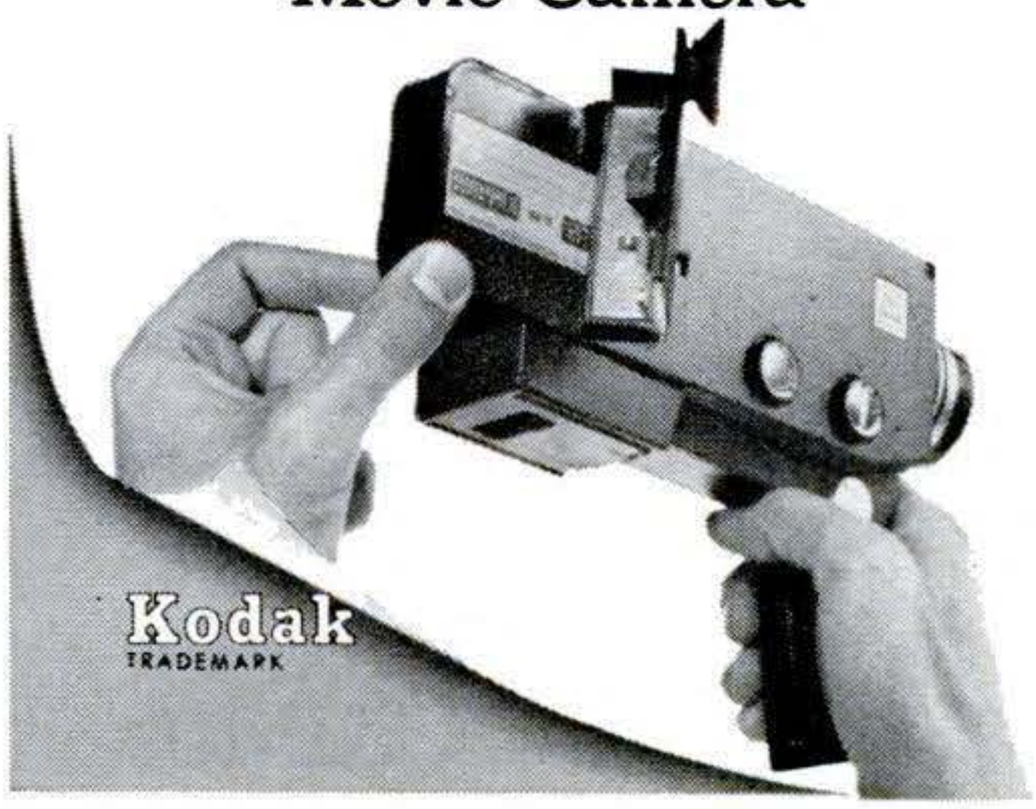

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(Continued from page 217)

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Gadgets for Your Stereo: Are They Any Good?

[Continued from page 142]

test reels indistinguishable from new tapes.

Tape-head demagnetizer. The motion of recorded tape past your recorder's playback, record, and erase-head assembly slowly magnetizes the heads. That's why tape-machine manufacturers recommend that you demagnetize the heads after every few hours of play. If you don't, the magnetized heads add hiss to the tape moving past them. Since a demagnetizer costs less than one reel of high-quality prerecorded tape, it's a good investment.

Head-cleaning tape. As tape moves past the head assembly, minute oxide particles are scraped off and, in time, build up on the head surfaces. As a result, the tape no longer makes close contact with the heads.

The time-honored head-cleaning device is a cotton swab saturated with an alcohol-base head-cleaning solution. Far newer is the tape that you saturate with solution and run through the tape transport like magnetic tape. It works, but the solution may damage plastic and rubber parts, and the rough cloth tape may injure the pressure pads, as the tape feeds through.

Tape splicers. You'll rarely need a splicer unless you edit your recorded tapes. The splicer holds the tape ends in position while you join them with splicing tape. We found that a "free" splicer that's molded into every seven-inch Kodak tape reel works as well as a $4 splicing kit and a $10 machine.

Self-threading reel. This gadget is great fun to watch, but we found a rub: It worked beautifully on a horizontally mounted tape machine, but very erratically on a vertically mounted test recorder. PS

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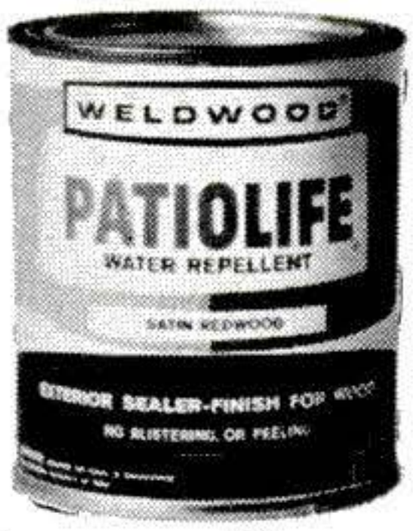

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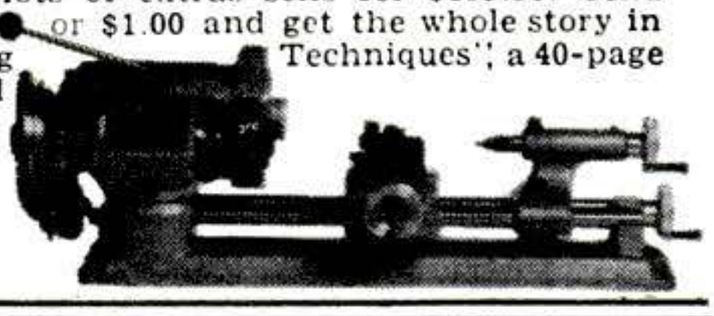

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Power-Tool Workbench

[*Continued from page 181*]

to the corners of a sheet of plywood make the dolly. A word of caution: Use good, heavy-duty casters; you'll appreciate their sturdiness every time you load the dolly.

The electric outlet is mounted on the underside of the front edge of the bench—facing down. This way, plugs don't protrude in front of the bench or get in the way of work supported by the vise.

A coat of penetrating wood sealer—Firzite, Rez, or the like—toughens the bench, makes it wear longer and look cleaner. For maximum protection, cover the plywood edges with polyester resin.

Cut tops for the working surfaces from ¼" tempered hardboard and attach with screws. This makes a smooth, dense work surface, and when it's badly damaged it can be readily replaced by a new panel.

Getting rid of the power cords does a lot more than just make this workbench look tidy. It puts an end to the frustrating tangle of cords underfoot—and it puts an end to the nuisance of being hung up in mid-cut by a fouled trailing cord. Industry has used this overhead-cord system for years. We have merely adapted it to home use.

The system has two components. One is an automatic reel, the other a set of electrical connectors that can be locked together, yet quickly separated. A male connector is mounted on each tool in place of the cord.

This system isn't confined to use in the shop; an adapter lets you use regular extension cords.

Mounting the reel. The reels are common electrical-supply items. Use one loaded with a 16-gauge, three-wire cord. Plug it directly into a wiring outlet; don't use it with an extension cord.

The reel used here is a Cordomatic s/900G, with 25 feet of 16/3 SJO cord. It comes with a complete mounting kit. Mount it on a joist over the work area, next to an outlet not used by the shop lighting fixtures.

Adapt the reel for interchangeable tool service by replacing the lamp socket with a Hubbell Twist-Lock connector body #4730. This accepts Hubbell Twist-Lock plugs #4726, which can be adapted for mounting on each tool.

Hubbell #4726 caps can be mounted on the tool itself with no cord at all. However,

Continued

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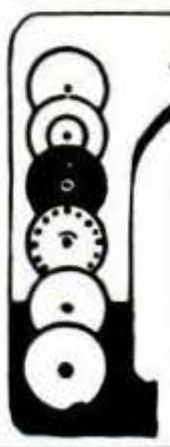

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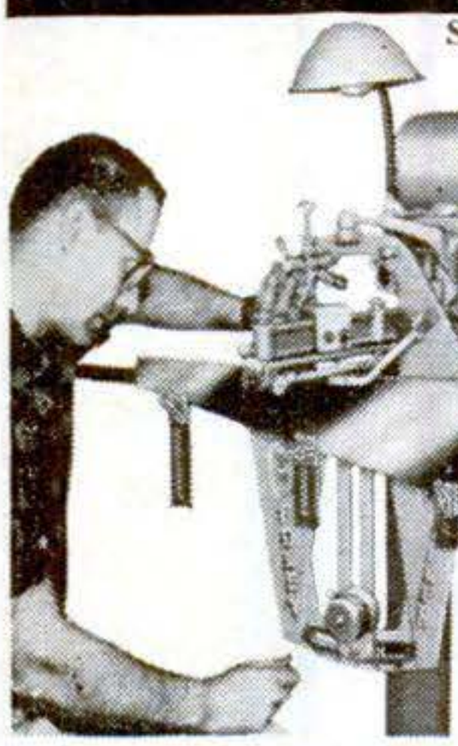

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where electrical terminals aren't accessible, the #4726 cap can be mounted on the original cord, shortened to a few inches.

To adapt the Hubbell #4726 caps for use with no cord at all, first remove the cord clamps from the cap body.

Then, with a file or reamer, remove the narrow ridge around the top edge of the cord hole in the cap body. The hole itself is just the right size—about 9/16"—to accommodate male ¼" iron pipe threads. (Use continuous-thread electrical nipples, not plumbing fittings.)

Cement the continuous-thread nipple into the cap body with epoxy and let it cure. To secure the cap to the tool, use two ¼" threaded nuts to clamp the cap in the hole vacated by the tool's original cord sleeve.

Sometimes modifications are necessary. If the cord hole is too small for the pipe, try expanding it with a ¼" thread tap—you may be able to thread the cap directly into the tool and lock it there with a single jam nut. Or, if the cord hole is too large, use ½" flat washers on each side of the clamp; they'll usually slip over ¼" pipe.

For plug-in-anywhere cordless tools, build one or more adapter cords consisting of a Hubbell #4730 connector body, some heavy-duty cord, and a standard three-prong plug. With a few inches of cord, make another adapter consisting of a #4726 Twist-Lock plug and an ordinary three-prong adapter. PS

MATERIALS

3 panels ¾"x4'x8' fir plywood
1 panel ¼"x4'x8' tempered hardboard
1 panel ¼"x4'x4' tempered hardboard
1 panel ⅛"x4'x4' perforated hardboard
3 pcs. 2"x6"x12' lumber
1 pc. 2"x4"x8' lumber
1 pc. 7/16"x12" hardwood dowel
1 Corbin sliding-door lock
1 flush cabinet lock
60" plastic sliding-door track
4 2½" swivel-plate casters
34½"x1½" continuous hinge with screws
12 ⅜"x3½" carriage bolts
1 5/16"x3" carriage bolt
2 ¼"x3" carriage bolts
2 5/16" flat washers
2 ½" flat washers
24 3" #14 FH wood screws
18 2" #12 FH wood screws
25 ¾" #8 FH wood screws
200 1½" #8 FH wood screws
1 Cordomatic s/900G retracting reel
2 Hubbell #4730 connector bodies
1 Hubbell #4726 cap (one for each power tool and extension cord)
1 (for each tool) ¼"x2"-long pipe nipple
2 (for each power tool) ¼" nuts
2 3-prong plugs
10' 3-wire #14 rubber-covered cord
1 duplex outlet
1 BX angle connector

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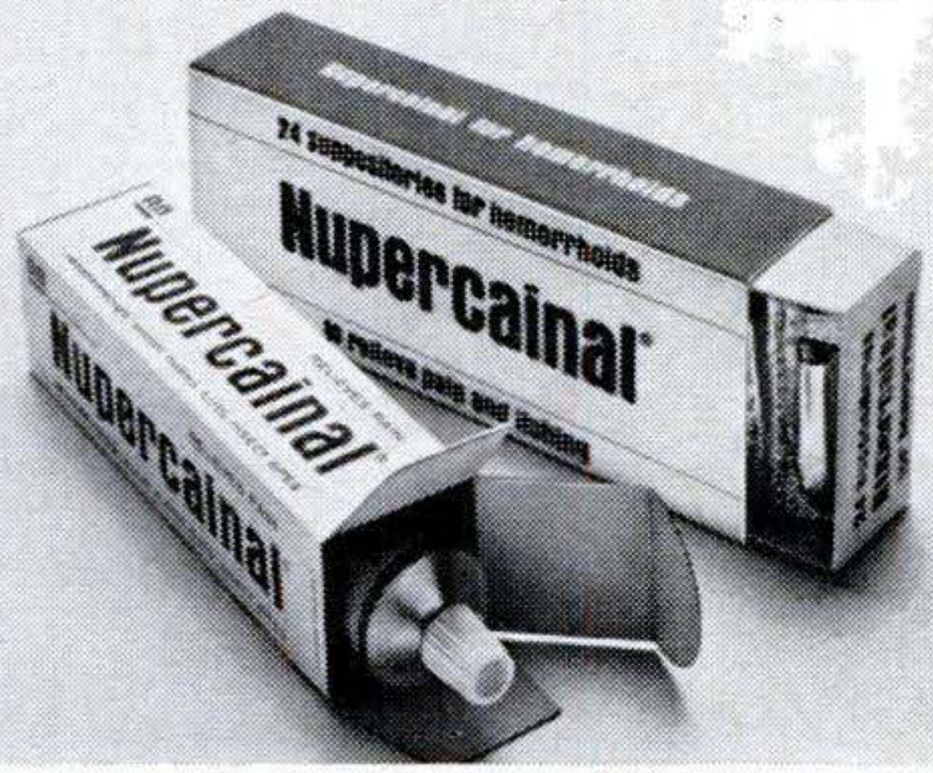

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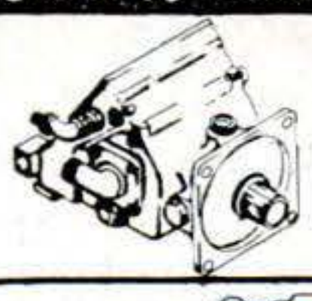

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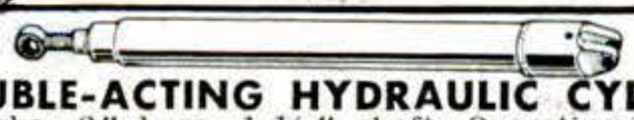

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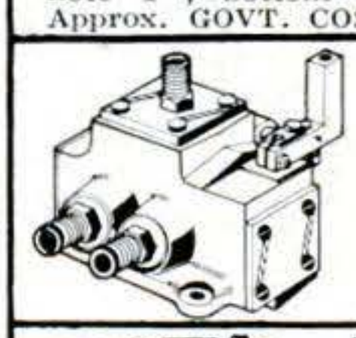

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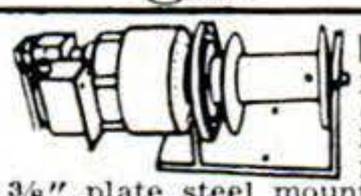

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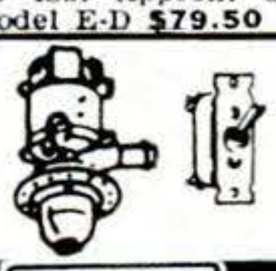

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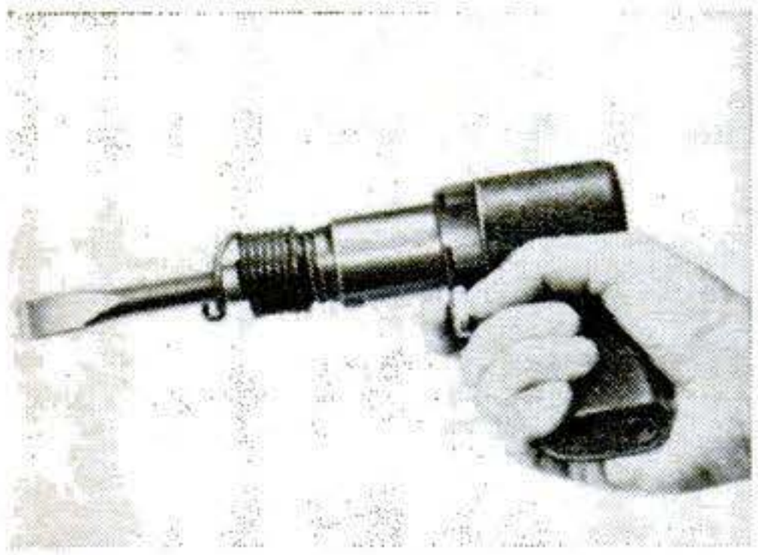

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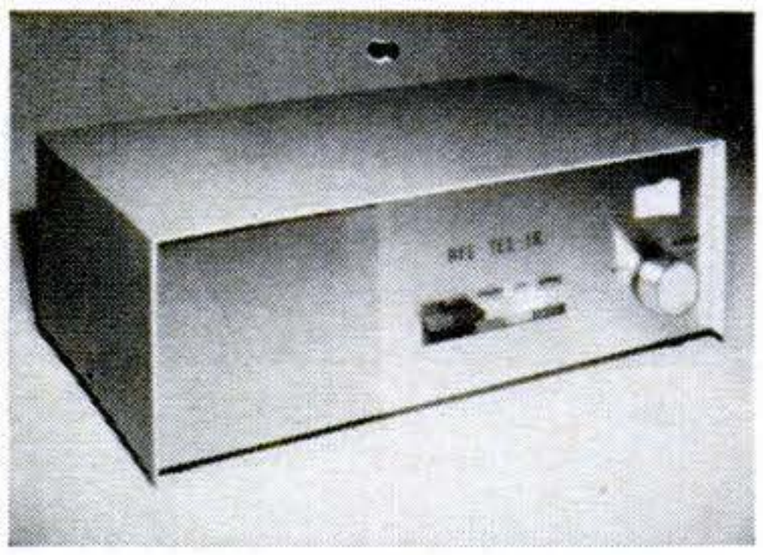

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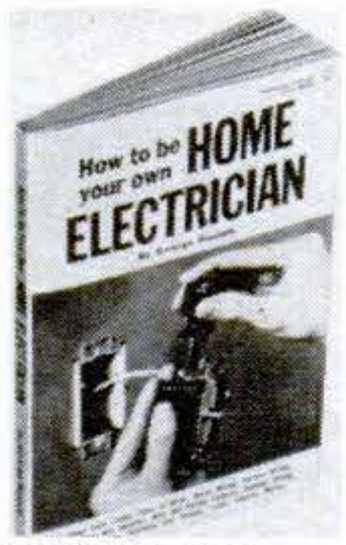

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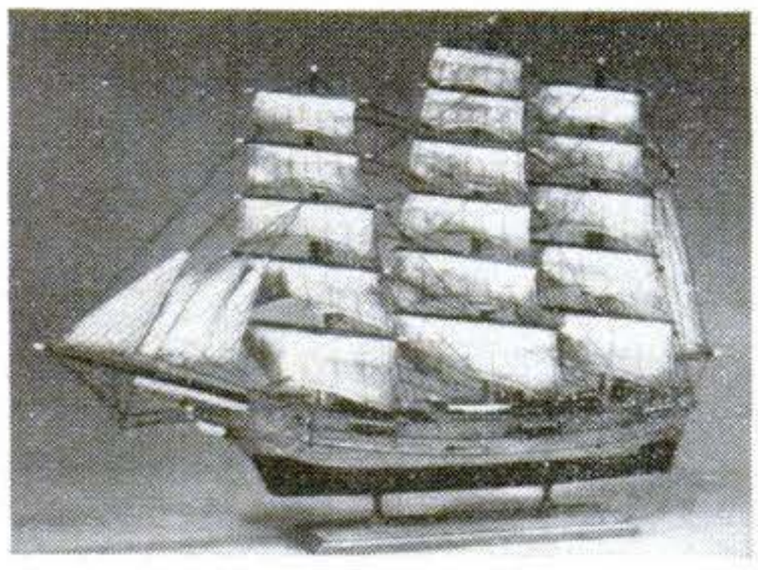

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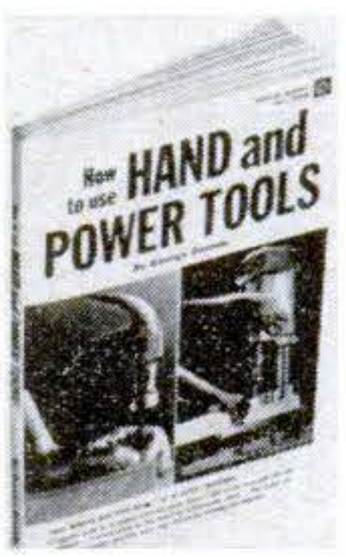

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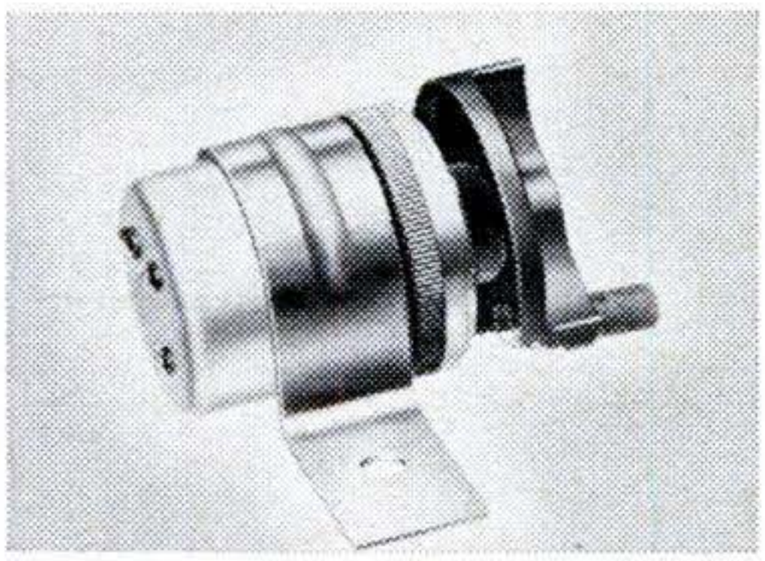

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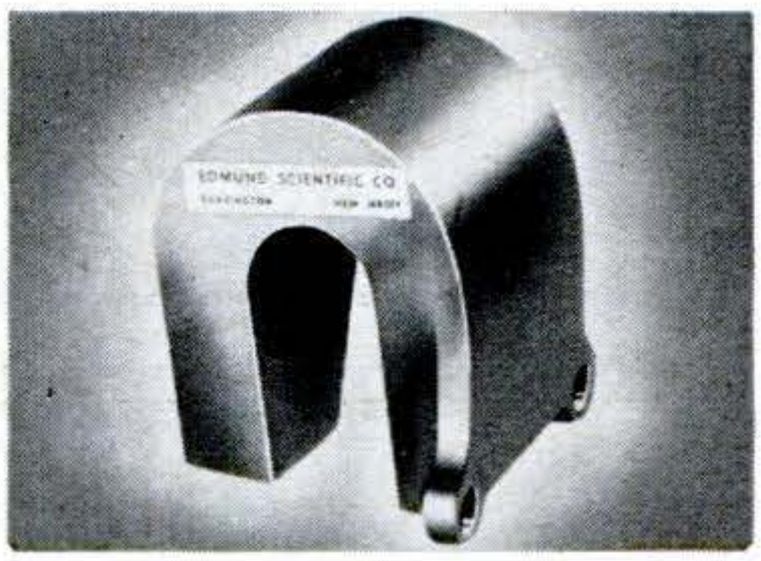

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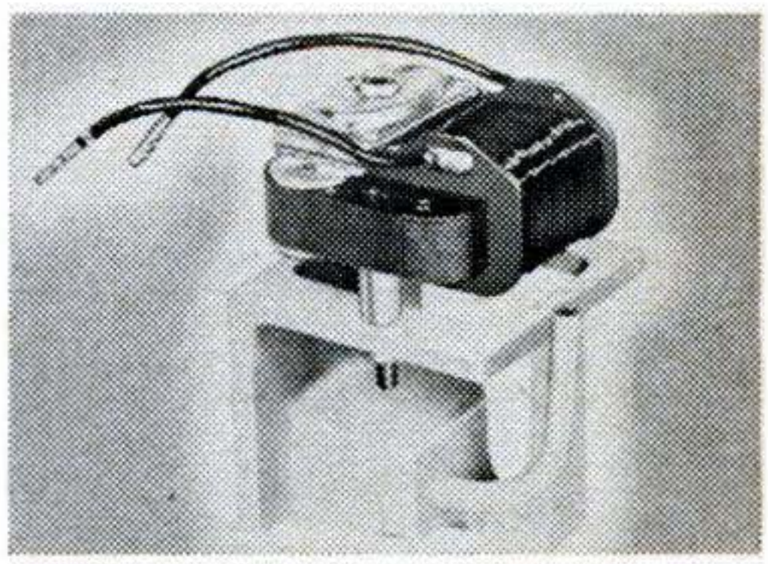

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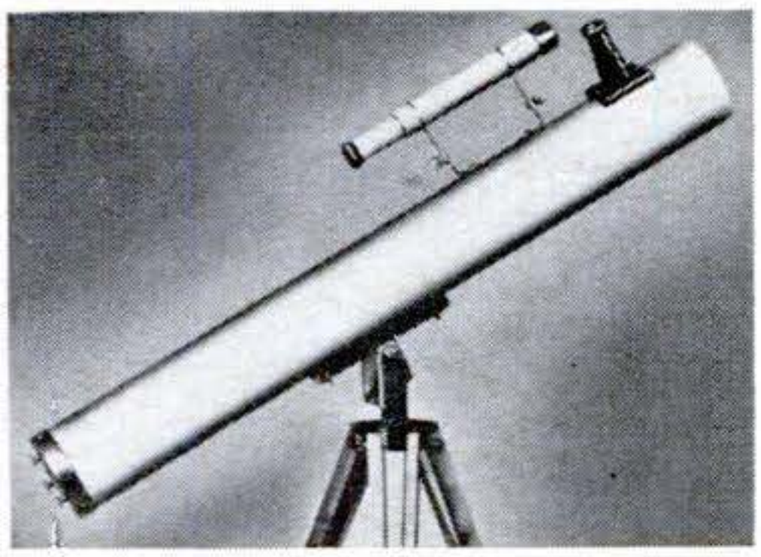

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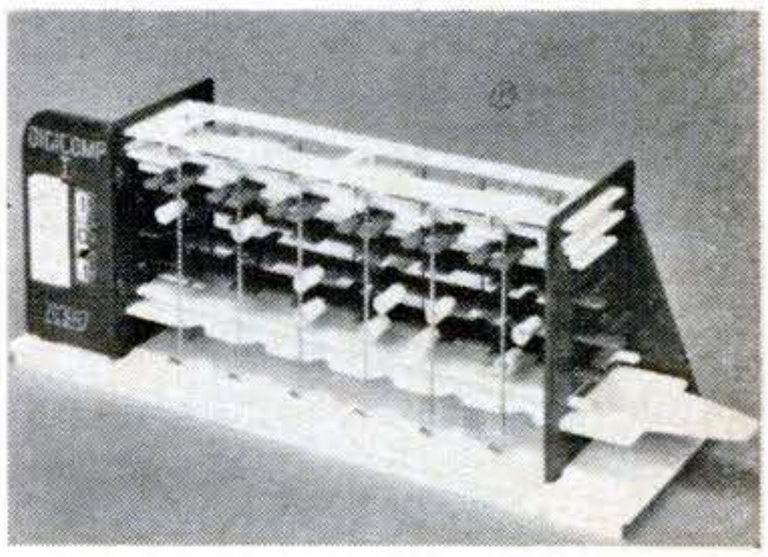

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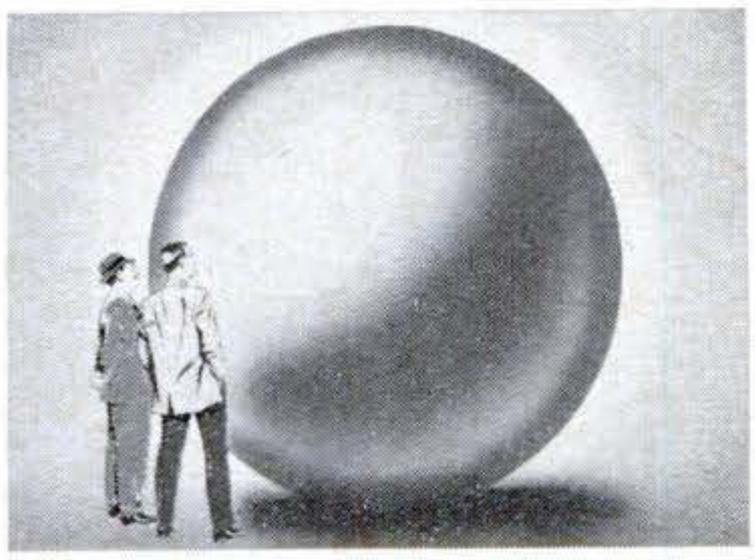

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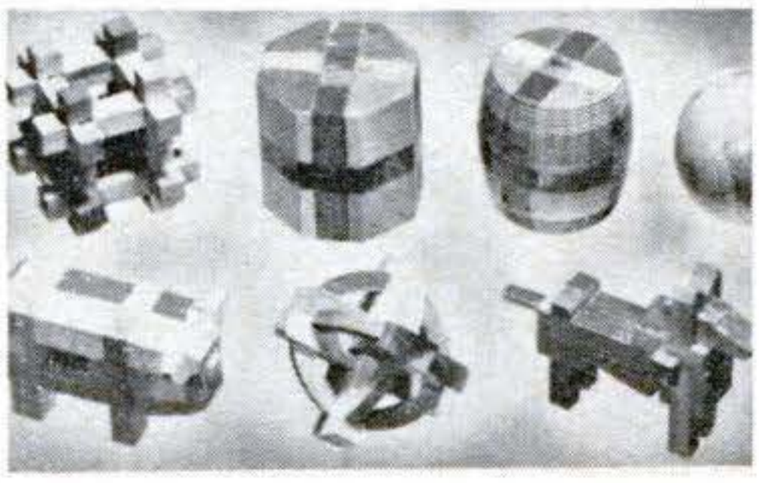

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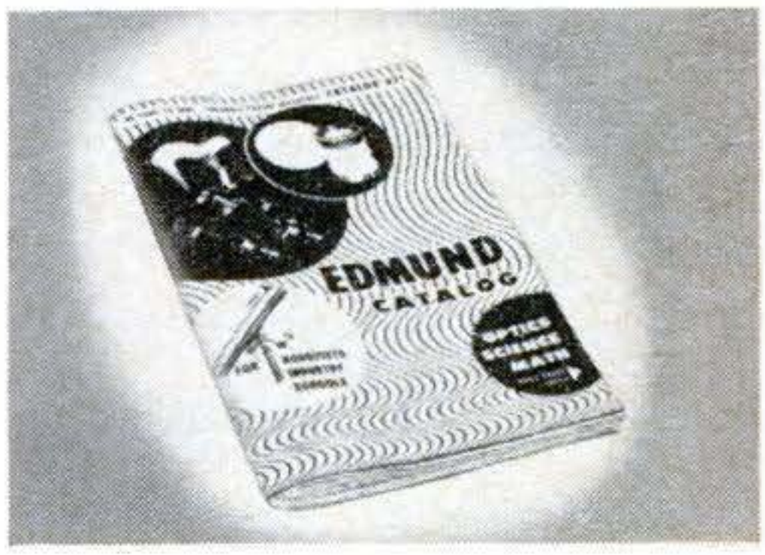

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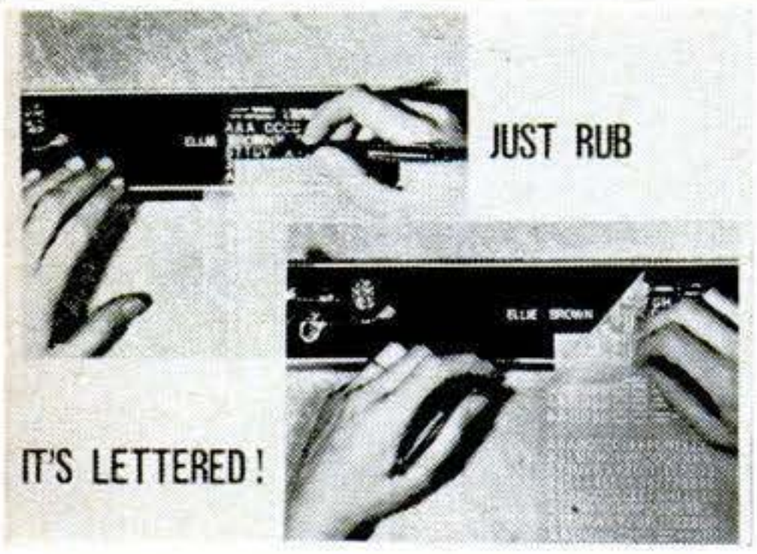

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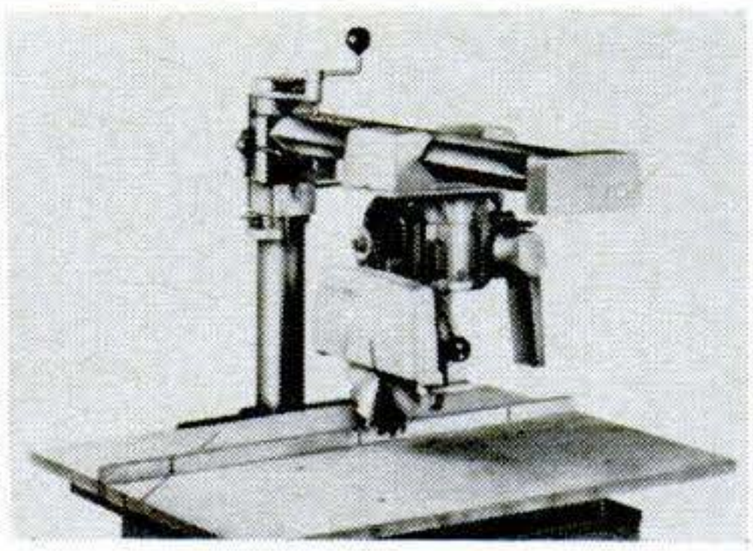

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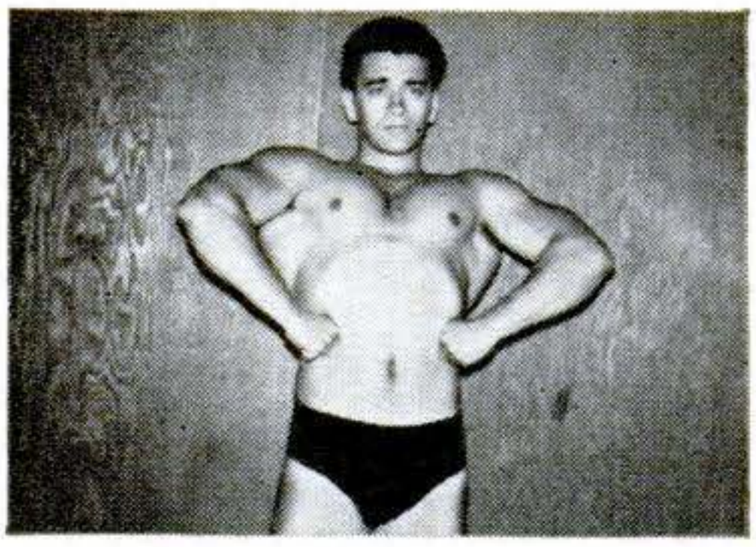

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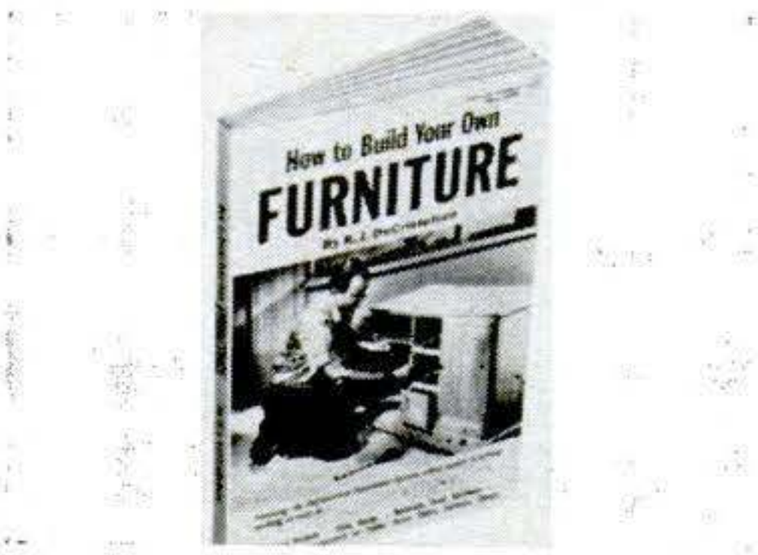

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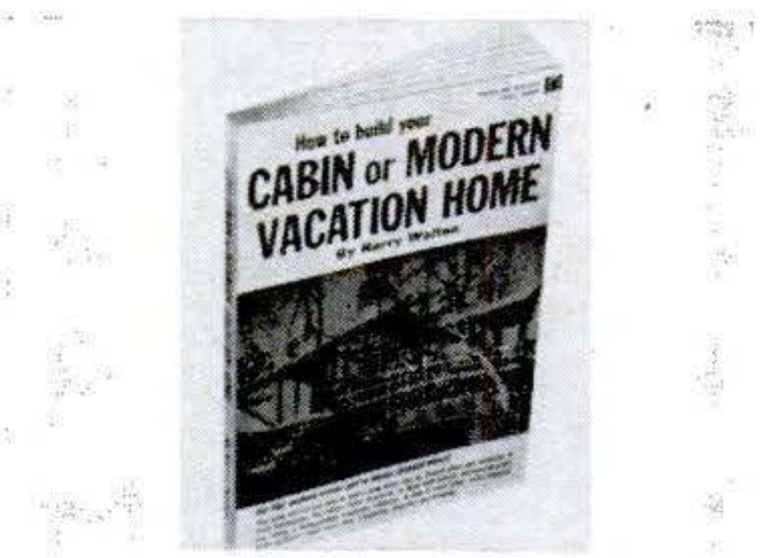

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Please send me the units checked. Payment in full enclosed $..... or $3 deposit each item enclosed, balance C.O.D. ☐ I MUST BE FULLY SATISFIED OR WILL RETURN UNIT WITHIN 10 DAYS FOR FULL REFUND. No questions asked.

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- ☐ Set of 3 High Speed Turning Chisels at $4.95
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OVER A MILLION USERS confirm their precision, versatility and rugged performance.

✱10-YEAR FULL SERVICE GUARANTEE . . . Any part or parts of any AMCO power tool (except motor) which may become inoperative for any reason within **ten years** after the purchase date will be repaired or replaced by the factory without cost to the purchaser. Your only cost: for postage.

8" TILT ARBOR POWER SAW

DOES WORK OF $75 BENCH SAW as is. Converts easily to equal any $300 floor model cabinet units! Crosscuts, rips, mitres, cuts compound angles, dadoes, makes coves and mouldings.

$14.95 f.o.b. factory. Wt. 25 lbs. Includes completely assembled cast iron and steel 8" saw with ground cast iron table . . . less blade. RIP FENCE, if desired, for easier work alignment, $3.50 add'l.

SAW BLADE TILTS . . . TABLE STAYS LEVEL • Locks securely at any angle up to 50°, raises, lowers 0"-2¼". Patented tilt mechanism, accurate etched scale. Patented motor mount takes std. ¼ h.p. or larger motor, keeps belt tight, assures perfect alignment at any angle, transmits full power. Takes std. blade, saw insert removes to take dadoe heads, cutters, etc. (not incl.). Accurate mitre gauge assembly. Ground spindle. Enclosed steel base. "Compo" bearings. Accessories available at factory prices. RIP FENCE, if desired for easier work alignment: Std. size (for bench saw) $3.50; larger fence (for cabinet base, as ill'd.) $4.50.

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6" SWING 3-FOOT LATHE

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Optional faceplate for turning bowls, trays, lamp bases, rosettes, etc. $2.50.
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DOES THE WORK OF $40 UNITS . . . with same precision and speed. Turns wood, plastic. Sturdy cast iron with tubular steel bed. Ball thrust cup center, spur center, T-rest assembly, lever action tail stock, 2-speed pulley. Fits any motor.

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FULL 22" LONG, 4⅛" JOINTER-PLANER

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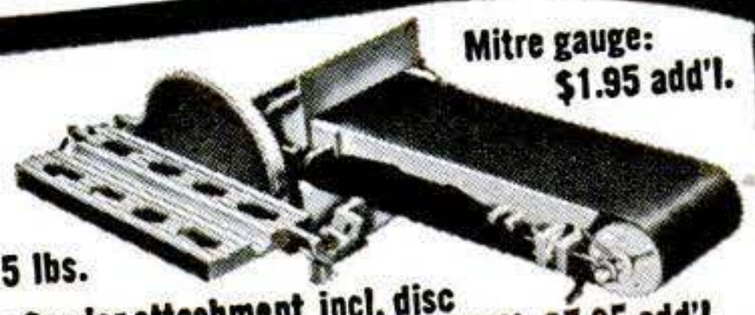
f.o.b. factory. Wt.: 19 lbs. Complete as shown.
100% precision ground cast iron and steel.

DOES THE WORK OF $60 UNITS . . . Professional power planing at a hand tool price. Make faster, more accurate joints, rabbetts, bevels for windows, doors, drawers, square tapered legs—Adjustable precision ground cast iron tables. Patent-pending design holds knife to table clearances at any depth. Rabbett depth ⅜". Fence adjustable 0°-50°. Hardened, ground hi-speed steel knives. Dual cutter guards. Balanced cutter head.

10-YEAR FULL SERVICE GUARANTEE*

PRECISION 4" x 36" BELT SANDER



Mitre gauge: $1.95 add'l.

f.o.b. factory. Wt. 15 lbs.

$14.95 †Disc Sander attachment incl. disc bracket, ground cast table (tilts 0-45°): $7.95 add'l.

DOES WORK OF $50 SANDERS . . . The world's most talented belt sander. Heavy cast sander incl. 4" x 36" sanding belt, V-pulley drive, multi-purpose drive spindle. Changes from horizontal to vertical sanding in secs. Uses ⅓ hp or larger motor.

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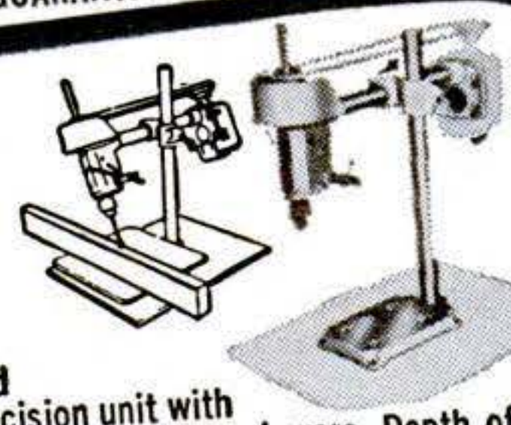

All cast iron and steel
f.o.b. factory Wt. 30 lbs.
½" cap.
Jacob's chuck incl.

$29.95

DOES WORK OF $90 UNITS . . . and much more. Industrial quality precision unit with all standard features, many extras. Head raises, lowers. Depth of throat up to 16". Pre-set to any angle for on-or-off table drilling, even horizontal drilling. **10-YEAR FULL SERVICE GUARANTEE.***

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At the races a man asks him for change of a $50 bill.

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It was a 1950D bill. It had Henry Fowler's signature. It should have had Douglas Dillon's.

The man who knows how to take care of himself uses Vaseline® Hair Tonic.

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